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SOME NUTRITIONAL AND PHYSIO-PATHOLOGICAL OBSERVATIONS IN RATS FED "CHEMICALLY-TREATED" COCONUT MEAL

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A number of investigators have estimated the protein quality of different types of coconut preparations on the basis of their amino-acid composition, or by means of growth and nitrogen balance methods. Bendaña-Brown et al(2) analyzed the amino acid content of copra meal using the microbiological methods and found it to be deficient in lysine, tryptophan, histidine, and methionine in that order relative to the proportion of amino acids required by the growing rat. Concepcion and Cruz (4) computed the egg ratios (percentage ratios of amino acids in food protein relative to their content in whole egg protein) in coconut flour and their data showed that tryptophan is the most deficient amino acid followed by cystine, methionine, lysine, and histidine. In addition, Miranda et al(7) presented data on the proportionate requirements for essential amino acids for young rats and proportionate concentrations of these amino acids in coconut protein isolates and coco flour revealing that tryptophan is the most limiting amino acid followed by lysine, phenylalanine, histidine, and threonine.

In spite of the apparent inadequacy of the coconut protein for some of the essential amino acids, animal studies indicate the high quality of coconut protein as shown by its ability to promote reasonable growth in rats and its high biological value. (5, 7, 8) It appears, therefore, that the nutritive value of protein foods should not be solely judged from their amino-acid

composition and that assessment of the food should be made also as they are eaten by animals or man.

The present paper is an account of the author's observations on the growth-promoting value and effects of a new type of coconut meal preparation on the albino rat. The said meal has undergone a special process during its production known as the "chemical dip treatment" introduced by Subrahmanyan et al.(10) This involves the dipping of fresh coconut kernels in a mixture of 5-per cent sulfuric acid and 7-per cent acetic acid before drying for oil extraction and meal/flour production. Thus it is desirable to know whether the chemical treatment employed would modify the nutritional value of the proteins of the coconut meal. The over-all effect of the treated coconut meal on protein metabolism as reflected in the hemoglobin and plasma protein levels, on cholesterol synthesis, and on the structure of certain tissues of the experimental animals was also taken into consideration.

EXPERIMENTAL

a. Diets.—Two foodstuffs; namely, coconut meal that was subjected to chemical dip treatment (hereinafter known as treated coconut meal), and coconut meal without undergoing the above process (untreated) were tested, with casein as control. Each protein food was incorporated into the diet at the expense of cornstarch (Table 1–A). A diet containing the treated coconut meal supplemented with 0.2-per cent tryptophan and a high-protein (24-per cent) colony stock diet (Table 1–B) were also prepared. All diets with the exception of the latter contained approximately 10-per cent crude protein and were similar in composition in other respects.

TABLE 1.—*Percentage composition of diets.*

A. Experimental diets:

Ingredients	Diet			
	I	II	III	IV
Casein	11	----	----	----
Coconut meal (treated)	----	50.0	----	50.0
Coconut meal (untreated)	----	----	50	----
Salt mixture	4	4.0	4	4.0
Crisco (hydrogenated cottonseed oil)	8	5.7	7	5.7
Cod liver oil	2	2.0	2	2.0
Wesson oil with tocopherol	2	2.0	2	2.0
Vitaminized cornstarch	5	5.0	5	5.0
Alphace	5	2.9	----	2.9
De-tryptophan	----	----	----	0.2
Cornstarch	63	28.4	30	28.2

B. Colony stock diet—ingredients:

Dilis	24	Vitaminized corn-starch	2
Malunggay	8	Crisco	8
Ground rice	36	Cod liver oil	2
Darak (rice bran).	20		

b. Animals.—Male Albino rats, 21 days of age, were selected for the determination of the protein efficiency ratio of the test foods by the standard method proposed by Campbell.(3) They were divided into groups of 10 according to weight and litter origin. The females included in this study were disregarded for PER determination since they do not gain in weight as rapidly as the males. However, they are useful in providing extra information on the effects of the diets on some metabolic processes.

The animals received their respective diets in a period of 4 weeks. Diet and water were offered *ad libitum.* The rats were caged individually throughout the experiment and each was weighed daily except on week-ends. At the end of the feeding period, blood was collected by cardiac puncture for analysis of hemoglobin, plasma protein and plasma cholesterol. The rats were subsequently killed and the liver, kidneys, spleen, heart and adrenals were excised, blotted and weighed. Representative samples of each of these tissues and from the lungs, testes and uterus were then fixed in formalin, sectioned and stained with eosin and hematoxylin.

Total cholesterol was analyzed from blood plasma by the method of Zak et al(12) while total plasma protein was determined by the micro-Kjeldahl method.(1) Hemoglobin was estimated by the colorimetric method.

RESULTS AND DISCUSSION

Table 2 shows the protein efficiency ratios of treated coconut meal, untreated coconut meal and casein to be 2.12, 2.20 and 2.49, respectively. The difference between the PER of the two coconut meal preparations is not statistically significant ($P=0.05$) indicating that the chemical treatment of the coconut

TABLE 2.—*Protein efficiency ratio of casein and treated and untreated coconut meal*

	Protein efficiency ratio
Casein	2.49 ± 0.16*
Treated coconut meal	2.12 ± 0.08
Untreated coconut meal	2.20 ± 0.09
Treated coconut meal with tryptophan	2.24 ± 0.08

* Mean ± standard error

kernels employed by Subrahmanyan et al(10) does not affect the nutritive value of the protein in the coconut meal. The coconut meal, however, treated or untreated, showed a lower protein quality than casein. The latter has a PER value of 2.49 which is significantly higher than either that of the treated or untreated coconut meal. Moreover, supplementation with the limiting amino-acid tryptophan, did not bring about any significant improvement in the PER of the treated coconut meal.

The food intake and efficiency of food utilization (grams gained per 100 grams food consumed) of the experimental animals are presented in Table 3. These data are important in evaluating the acceptability of the diet as well as the effects of amino-acid imbalance/deficiency. The male rats given the coconut meal diets were observed to require an initial period of adjustment to their diets. They manifested a reluctance to eat as much as the controls during the first week. This might be due to the palatability of the diets rather than amino-acid imbalance because in the succeeding weeks, the coconut meal diets became more acceptable to the rats, the weekly food intake being not significantly different from the controls. For the females, only those fed the treated coconut meal diet supplemented with 0.2-per cent tryptophan required an initial period of adjustment to the diet. During the third week, the food intake of these animals was as great as that of the group given the treated coconut diet without tryptophan supplement and it also exceeded that of the control group. While there was an improvement in the food intake of such animals (females), the efficiency of food utilization was not similarly improved during that week. It is to be noted further that for the entire experimental period, (1–4 weeks inclusive) the females fed the treated coconut meal diet with or without tryptophan supplement were less efficient than the controls in utilizing their food. The impaired utilization may be due to amino-acid imbalance or deficiency, or possibly due to the presence of a toxic factor. It is difficult, however, to put forward the mechanism that could account for the variation in sex on such an impairment of food utilization in the females. There was no impairment of food utilization in the males fed the coconut meal diets. The efficiency of food utilization of these animals was no different from that of the control after the first week (Table 3). Further examination of the data in Table 3 reveals that the supplementation of the treated coco-

TABLE 3.—*Food intake (FI) in grams per week and efficiency of food utilization (EFU) in grams per 100 grams food eaten, by weeks.*

Diet	Number and sex of animals	1		2		3		4		1–4 Inclusive	
		FI	EFU	FI	EFU	FI	EFU	FI	EFU	FI	EFU
Control (casein)	6M	*58.3	27.9	68.3	27.2	72.2	21.2	72.7	22.6	271.5	22.9
	6F	53.7	30.3	76.0	33.6	66.7	16.9	67.0	24.1	263.3	26.3
Treated coconut meal	6M	*45.7	*13.7	76.7	27.2	84.2	21.7	86.2	17.9	292.7	20.7
	6F	46.0	*17.4	77.8	27.5	*84.5	19.6	*82.2	*18.4	290.5	*21.1
Untreated coconut meal	6M	*46.2	*17.4	65.8	28.8	78.3	22.6	72.0	18.8	262.3	22.3
Treated coconut meal with tryptophan	6M	*39.0	*16.6	71.8	28.3	77.2	21.4	78.0	**25.6	266.0	23.4
	6F	*40.5	22.7	77.5	29.3	*83.0	18.3	78.8	20.2	279.8	19.9

* Difference from control, significant, P=0.05.

** Difference from treated coconut meat, significant, P=0.05.

nut meal diet with 0.2-per cent tryptophan does not seem to induce a beneficial effect on efficiency of food utilization of either male or female rats.

The influence of feeding diets containing coconut meal (treated or untreated) on some components of the blood of rats is presented in Table 4. The low hemoglobin values obtained in the males fed diets containing the treated or untreated coconut meal as compared to those values of the males in the control group and the normal controls is an indication of an interference in hematopoietic activity. An impairment of protein metabolism in both males and females receiving any of the coconut meal diets is further revealed in Table 4 by the relatively lower plasma protein values in these animals than those obtained from the normal controls. The low concentration of plasma proteins found in such animals is attributed to a dietary protein restriction on account of the low protein content (approximately 10-per cent crude protein) of the coconut meal diets. It is also due to the malfunctioning of the liver of those rats since the structure of this organ was altered by the abnormal accumulation of fat as observed upon histological examination. The liver is considered to be the site of formation of the plasma proteins and any disturbance in its functional capacity will thus be reflected in the plasma protein levels.

TABLE 4.—*Hemoglobin, plasma protein, total plasma cholesterol levels of rats at the end of 4 weeks on experimental diets.*

Diet group	Number and sex	Hemoglobin gm/100 cc	Plasma Protein gm/100 cc	Plasma cholesterol 100, gm cc
		Mean S.E.	*Mean S.E*	*Mean S.E.*
Control (casein)	6M	12.81 ±0.11	** 5.01 ±0.90	135.33 ±8.14
	6F	12.89 ±0.11	** 5.27 ±0.23	
Treated coconut meal (TCM)	6M	* 11.88 ±0.21	** 5.05 ±0.19	122.17 ±5.92
	6F	** 12.44 ±0.22	** 4.85 ±0.10	
Untreated coconut meal	6M	* 12.23 ±0.09	** 5.12 ±0.20	128.67 ±4.54
TCM supplemented with tryptchpan	6M	* 11.71 ±0.36	** 4.66 ±0.16	113.33 ±7.65
	6F	** 11.82 ±0.36	** 5.14 ±0.19	
Normal control (stock colony diet)	6F	13.52 ±0.41	6.76 ±0.35	115.33 ±3.87
	6F	13.41 ±0.32	6.30 ±0.09	

* Difference from controls and normal constrols, significant, P = 0.05.
** Difference, from normal controls, significant, P = 0.05.

Since hemoglobin formation or plasma protein production is regarded as specific functions of dietary proteins, some workers cited by Phansalkar and associates(9) have used either of the two for making an estimate of the protein quality of food

proteins. Accordingly, the data for hemoglobin (males) in Table 4 would otherwise point out the relatively lower quality of the proteins of the coconut meal compared to that of casein or of the stock diet employed in the present study. However, the data on plasma protein values did not show the above relationship for casein and the coconut meal preparations. This suggests that this criterion is not sensitive for evaluating difference in protein quality of foodstuffs.

Table 4 further shows that supplementation of the treated coconut meal diet with 0.2-per cent tryptophan has no favorable effect on hemoglobin or plasma protein synthesis. There is no significant difference between the hemoglobin and plasma protein values of rats fed the chemically treated unsupplemented diet and those obtained from the animals which received the tryptophan-supplemented diet. This apparently indicates that tryptophan is not the only amino acid that should be supplied by the treated coconut meal in adequate amounts for these physiological processes. Tryptophan is found to be most seriously deficient in the coconut meals in proportion to the requirement of the growing rat for this amino acid.

Plasma cholesterol analysis was conducted to determine the effect of feeding coconut meal on cholesterol metabolism. Mathur and co-workers(11) noted that some protein foods like Bengal gram which forms the staple diet of people in northern India have a hypocholesteremic effect and it is therefore interesting to find out whether or not coconut meal would also affect cholesterol metabolism in a similar manner. Hence, a comparison is given in Table 4 on the total plasma cholesterol of rats fed casein diet and of those given coconut meal diets. No significant differences were observed among those groups ($P = 0.05$) indicating that coconut meal is no different from casein in influencing the synthesis of cholesterol, that is, it has neither a hypo nor a hypercholesteremic effect.

Table 4 also gives the cholesterol values of normal rats fed the colony stock diet containing approximately 24-per cent crude protein. Such values are essentially similar to those obtained from rats fed the casein and coconut meal diets which contained 10-per cent crude protein. This finding may appear suprising because the rats given coconut meal diets developed fatty livers and total cholesterol values would therefore be expected to decrease. However, White and others (11) observed that in diseases of the hepatic parenchyma, the

concentration of total cholesterol in plasma remains in the normal range but the concentration of free cholesterol is elevated and that of cholesterol esters diminished.

The effects of the test diets on the weight of some organs of the rats are presented in Table 5. The organ weight data are given as percentages of the body weight (organ weight divided by the body weight $\times$ 100). The organs selected are those that would give an indication of physiological and anatomical abnormalities. For example, atrophy of the liver is quickly evident from the organ weight, just as evidence of gross metabolic abnormality, such as fatty liver is apparent from gross inspection. Also, an animal that has been continually exposed to stress, either metabolic or physical, reflects this through hypertrophy of the adrenal, just as lack of adrenal functions results in adrenal atrophy.

TABLE 5.—*Organ weights of rats fed casein, coconut meal, and stocks diets for 4 weeks.*

Organ	Number and sex	Organ weights [a]				
		Control	Treated coconut meal (TCM)	Untreated coconut meal	TCM with tryptophan supplement	Normal control
		Mean S.E.	*Mean S.E.*	*Mean S.E.*	*Mean S.E.*	*Mean S.E.*
Liver	6M	3.94 ±0.06 [b]	3.84 ±0.19 [b]	3.93 ±0.20 [b]	4.25 ±0.07 [c]	4.70 ±0.22
	6F	4.01 ±0.03	3.98 ±0.15		3.92 ±0.21	4.92 ±0.50
Kidneys	6M	0.76 ±0.01 [b]	0.77 ±0.02 [b]	0.78 ±0.01	0.80 ±0.01	0.86 ±0.02
	6F	0.77 ±0.02 [b]	0.78 ±0.02 [b]		0.80 ±0.06	0.91 ±0.04
Spleen	6M	0.28 ±0.025	0.23 ±0.009 [b]	0.24 ±0.005 [b]	0.23 ±0.006 [b]	0.29 ±0.004
	6F	0.25 ±0.008 [b]	0.24 ±0.004 [b]		0.22 ±0.007 [b]	0.31 ±0.025
Heart	6M	0.33 ±0.005	0.36 ±0.011 [d]	0.33 ±0.008	0.34 ±0.013	0.31 ±0.018
	6F	0.34 ±0.008	0.36 ±0.012		0.34 ±0.003	0.38 ±0.015
Adrenals	6M	0.014 ±0.002	0.014 ±0.002	0.01 ±0.002	0.023 ±0.001 [e]	0.013 ±0.00
	6F	0.016 ±0.002	0.016 ±0.001		0.018 ±0.002	0.016 ±0.00

[a] Percentage of body weight.
[b] Difference from normal controls, significant, P =0.05
[c] Difference from controls, significant, P =0.05.
[d] Difference from controls, of borderline significance but significant from normal controls, P =0.05.
[e] Difference from any of the other groups, significant, P = 0.05.

The statistical t-values for liver, kidneys and spleen to body weight ratios of males in the treated and untreated coconut meal diets indicated the decrease in weight of these organs, compared to the normal controls, to be significant. Decreased kidney and spleen weights were also seen in the females of the treated coconut meal group and of the group fed casein diet

in comparison to those of the normal controls. On the other hand, comparison of the organ weight data of the coconut meal groups and of those of the control group (casein diet) showed an increase in weight of the heart of males on the unsupplemented treated coconut meal diet and an increase in adrenal weight of males fed the tryptophan-supplemented treated coconut meal diet.

Microscopically, the most significant abnormality noted in the organs of the animals examined was the moderate to severe fatty changes in the liver of rats fed the diets containing chemically treated or untreated coconut meal. The number of vacuoles (fat) present in hepatic cells were greatly increased and the normal architecture of the liver was lost. Mild fatty infiltration of the liver was also observed in the rats fed casein diet but none was observed at all in the normal controls. In the case of the former, the vacuoles were mostly confined in the periphery of the lobules of the liver in contrast to those found in the coconut meal groups where they were generalized in distribution. Those histological observations indicate that low protein diets may possibly cause a derangement of fat metabolism even in the presence of adequate levels of choline in the diet. Choline was incorporated into the diets in amount (0.2 per cent) required by rats for normal lipid mobilization. When 0.2-per cent tryptophan was added to the treated coconut meal diet to correct the deficiency for this particular amino acid, fatty change in the liver was not also alleviated although tryptophan is known to exert a lipotropic effect in certain cases.

Since the development and severity of fatty change in the liver is influenced not only by the quantity but also by the quality of dietary proteins, the microscopic changes observed in the liver would further suggest that the proteins of coconut meal are lower in quality than casein. It is to be expected, however, that a high quality protein like that of casein, must maintain a normal liver fat in association with a comparatively good growth response when fed at a level higher than 10 per cent of the diet.

SUMMARY

The protein quality of coconut meal subjected to a chemical dip treatment was estimated by the growth of weanling rats. The protein efficiency ratio of the chemically treated coconut

meal was 2.12 while that of the same meal prepared under identical conditions except for the chemical dip treatment was 2.2. The differences between the two values is not statistically significant indicating that the chemical dip method of preserving the coconut kernel does not affect the protein quality of the meal. Casein, however, had a PER of 2.49 which is significantly higher than any of the two coconut meal preparations. Supplementation with the limiting amino acid, tryptophan, did not increase the PER of treated coconut meal.

The effects of feeding coconut meal, treated or untreated, and with or without tryptophan supplementation on some physiological functions and structure of certain tissues of the rat were determined also.

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A STUDY OF COLOR CHANGES IN STORED PAPAYA NECTAR

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FOUR TEXT FIGURES

INTRODUCTION

In the marketing of fruit juice concentrates for beverages or confectionery purposes, the lack of color stability of the product especially on unrefrigerated storage has presented a problem. Although the relation between color and flavor changes in fruit concentrates has not been definitely established, nevertheless, a change in color in such products generally lowers the eye appeal and hence their saleability as well.

Color changes in fruit juices have been reported by several authors.(1, 2, 4, 9, 10, 12, 13) In recent years, a large amount of work has been done to determine the nature of the browning reactions by using simple synthetic mixtures of various substances.(3, 6, 8) The browning of fruit juices on storage has been traced to one or a combination of the following factors: heat, metals, sunlight, oil constituents, amino acids, polyphenols, microorganisms and chemical oxidizing and reducing agents in the beverage.(7, 15)

Color changes occurring in fruit juices during storage are not necessarily uniform, but vary with the specific fruit. Color changes were reported to be prominent in juices which normally possess high color.(10) The natural plant pigments may change in tint or hue during preparation, processing or storage of the fruit products. The exact nature of the brown substances is still largely unknown although it has been commonly attributed to the Maillard reaction.

The addition of ascorbic acid to fruit juices, except for blueberry and grape juices, accelerated color deterioration in the form of progressive bleaching.(12, 14) When added to apple juice or cranberry juice, ascorbic acid had a marked effect on the lightening of color and in retarding darkening during storage. This effect has been attributed to the reducing action of ascorbic acid.

The control of enzymic browning in industry is based on the assumption that this browning is largely due to interaction of the enzyme, polyphenolase, with molecular oxygen and a suitable phenolic substrate. A review presented by Joslyn and Ponting(7) reports that enzymic browning is controlled by selection of varieties of fruit least susceptible to discoloration either because of the absence of the phenolic substrate or the presence of the substrate or enzyme at low concentration; selection of the fruit at the stage of maturity at which discolaration is at a minimum; removal of oxygen from the fruit tissues as well as from the atmosphere surrounding the fruit; addition of acids to reduce the pH and so reduce phenolase activity; addition of antioxidants or reducing substances which may act either by reducing free oxygen concentration or as phenolase inhibitors; addition or treatment with permissible inhibitors as salt; and heat inactivation of the phenolase.

Papaya (*Carica papaya* Linn.), is one of the most common fruits in the Philippines and it is available the whole year round. It is a nutritious breakfast item because it is an excellent source of ascorbic acid and a good source of provitamin A and potassium.(5)

Papaya nectar is produced on a commercial scale by some local food manufacturing companies, both for export and for local consumption. No detailed study so far has been done on the changes taking place on storage of the product. This investigation therefore was undertaken to study the effects of various factors such as temperature, light, oxygen, additives, etc. on the stability of color of papaya nectar on storage. Since the relation between color changes and flavor changes have not yet been definitely established, the present study attempts only to follow changes in color during storage. The latter requires a separate study.

EXPERIMENTAL PROCEDURE

Papaya nectar was prepared from fruits purchased from local markets around the city of Manila. The following general procedure was followed in the preparation of the experimental packs: Sound, and fully ripe fruits were washed, peeled and cut into halves. The seeds were removed and the pulp comminuted in a Waring blendor to produce a smooth puree. To one volume of the puree, two of 35° Brix syrup was added

and sodium benzoate and citric acid equivalent to 0.05 per cent and 0.3 per cent, respectively, were added to the mixture. The mixture was pasteurized at 85°C for 5 minutes, immediately poured into previously sterilized bottles of the crown-closure type and sealed immediately. The bottles were laid on their sides for about 1 minute to sterilize the crowns, then allowed to cool in a bucket of water. When sufficiently cool, the samples were stored according to the conditions of the experimental design.

The following experimental conditions were studied:

a. Effect of temperature.—One lot of juice sample was stored in a refrigerator (4°—5°C) and another lot at room temperature (29°—31°C) in an open cabinet.

b. Effect of diffused sunlight.—Juice samples were stored in a sunny place near an east window of the laboratory and corresponding control samples were placed inside a cabinet.

c. Effect of added ascorbic acid.—A portion of the prepared juice was fortified with ascorbic acid equivalent to 50 mg/100 cc before pasteurization. The unfortified sample served as the control. Both treated and control samples were divided into two portions, one portion was stored at room temperature in an open cabinet and the other, in the refrigerator.

d. Effect of bisulfite.—A portion of the prepared juice was treated with 2,000 ppm of potassium metabisulfite before pasteurization. The untreated sample served as the control. The experimental samples were stored in the same manner as in (*c*).

e. Effect of headspace.—Samples with a headspace of 2 ¾ inches from the brim of the bottle were prepared. The completely filled bottles served as the control. The experimental samples were stored in the same manner as in (*c*).

f. Effect of type of container.—Samples were packed in plain tin cans, No. 211, for comparison with those packed in bottles and stored in the refrigerator and at room temperature.

g. Effect of added amino acids.—Samples with added gluttamic acid equivalent to 20 mg/liter were prepared. Glutamic acid was added during the pasteurization process. Dryden et al(4) in his study on color change in stored apple juice concentrates used aspartic acid, glutamic acid, and glutamine as amino acid sources. The untreated juice served as control sample. The experimental samples were stored in the same manner as in (*c*).

h. Effect of added sugar.—Juice samples were prepared with plain water or 35° Brix syrup as diluent, and kept at either room temperature and refrigerated storage.

Examination of juices.—Color changes in the stored juices were determined periodically every 2 months for a year. Color was evaluated by means of a Klett-Summerson photoelectric colorimeter. Aliquot portions of the juice samples were taken, centrifuged for 10 minutes until a clear supernatant liquid was obtained. The clear liquid was carefully decanted and diluted to an appropriate concentration (5° Brix) with distilled water so that light transmittance characteristics could be read with the use of a standard filter (No. 54) which has an approximate spectral range of 520 to 580 millimicrons.

Scale reading, proportional to absorbance or optical density, was used as an index of color or darkness.

RESULTS AND DISCUSSION

Table 1 shows the results of various conditions of packaging and storage on the color stability of papaya nectar. The color of the refrigerated sample increased from an initial reading of 0.062 to 0.085 at the end of 12 months while that stored at room temperature increased from 0.06 to 0.181 during the same period. The rate of darkening is a positive function of temperature. Similar observations have been reported by several authors(4, 9, 10, 11, 12, 13,) on various fruit juices.

The rate of color change did not differ appreciably for samples stored in the dark or in diffused light. This result shows that light has little effect on color.

The type of container did not produce a marked difference on the rate of darkening of the prepared papaya nectar stored at room temperature. The change in color was almost negligible during the first 6 months of storage after which a sudden rise was observed on both samples on the eighth month and thereafter.

A faster rate of increase in color value was observed in the partially filled bottles than in the corresponding control samples at both temperatures of storage. However, at low temperature storage the color difference between the completely filled and partially filled bottles was only evident at the eighth month. But, at higher temperature, color difference was apparent even only after the fourth month of storage.

TABLE 1.—*Optical density of papaya nectar packed and stored at various conditions.*

Storage Period (months)	Stored at two temperatures		Stored in diffused sunlight		Stored at room temperature in two different containers		Packed with headspace in bottle		Packed without headspace in bottle	
	R *	RT **	o †	o ††	Bottle	Tin can	R	RT	R	RT
0	.062	.060	.070	.07	.049	.049	.065	.065	.065	.065
2	.052	.068	.074	.075	.046	.049	.071	.085	.068	.081
4	.060	.064	.083	.096	.058	.052	.068	.116	.058	.083
6	.066	.088	.098	.118	.064	.062	.076	.110	.073	.094
8	.066	.111	.140	.166	.093	.085	.090	.132	.076	.150
10	.075	.134	.166	.184	.148	.136	.092	.185	.076	.174
12	.085	.181	.198	.201	.167	.165	.108	.204	.084	.180

Storage conditions and corresponding optical densities at 520 to 580 $m\mu$.

* Room Temperature
** Refrigerated Temperature
† Inside cabinet
†† Outsile cabinet

Figures 1 to 4 show the effects of various additives on the rate of color deterioration of stored papaya nectar. Figure 1 shows the rate of color changes of samples treated with glutamic acid and the corresponding control samples stored at two ranges of temperature. Results showed that samples with added amino compound (glutamic acid) increased in color reading much faster at both temperatures of storage than the corresponding control samples.

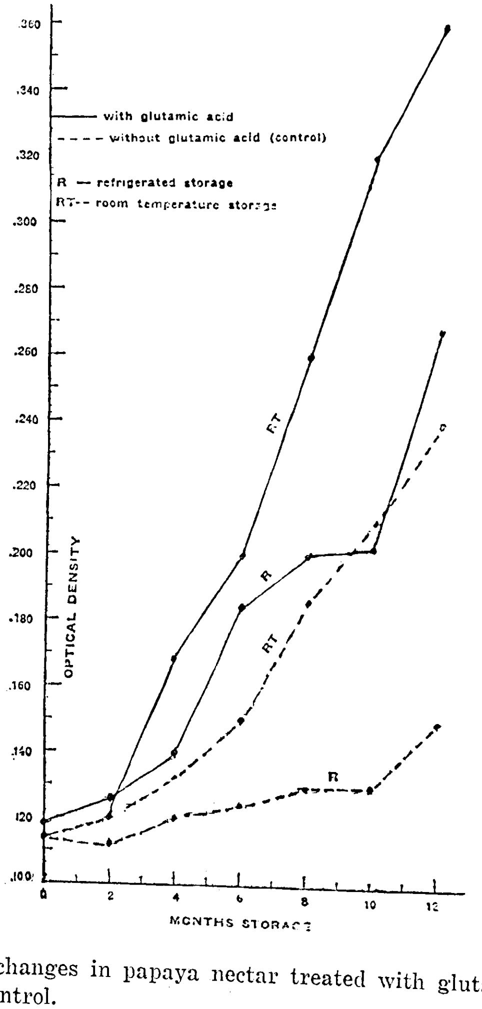

FIG. 1. Color changes in papaya nectar treated with glutamic acid and corresponding control.

Figure 2 shows the effect of added ascorbic acid. At low temperature, the rate of darkening of the treated and control

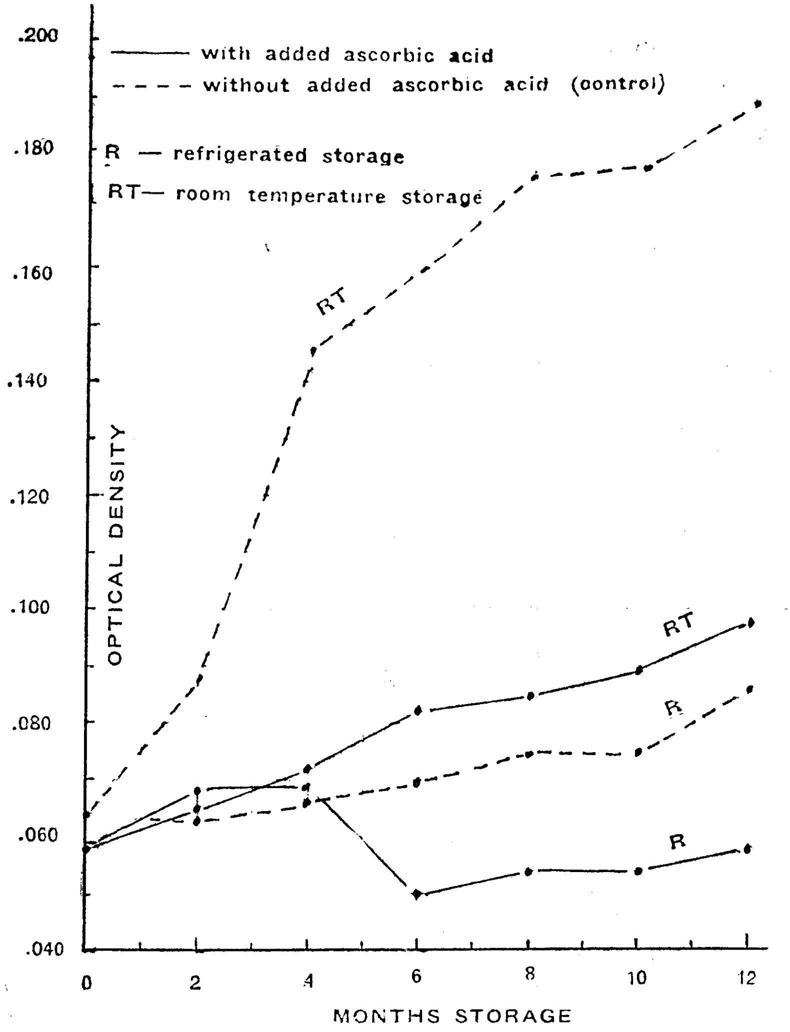

FIG. 2. Color changes in stored papaya treated with ascorbic acid and corresponding control.

samples were essentially comparable up to the fourth month of storage. On the sixth month, the treated sample showed a drop in the color value compared to the control, remaining at that level almost steadily even at the end of the study. At room temperature, the treated sample increased in color value from an initial of 0.06 to 0.098 while the untreated sample increased from 0.06 to 0.19 after 12 months. This phenomenon has been described as progressive bleaching or lightening effect. (10) A similar result was obtained in a study conducted on fortified mango nectar.(11)

The effect of the addition of sodium metabisulfite is shown in Figure 3. Bisulfite caused temporary lightening of color at both temperatures of storage. In refrigerated samples, the color value dropped at the second month and remained almost constant till the sixth month after which increase in color value was noted. At room temperature storage, bisulfite caused temporary drop in color value on the second month after which the increase was about the same as the untreated sample. At low temperature, the treated and control samples showed almost equal color value at the end of the study.

The addition of sugar did not affect the rate of change of color value of the samples stored at refrigerated temperature (Fig. 4). However, at room temperature, the increase in value of the treated sample was appreciably faster than the control. Sugar exerts its effect on color only at high temperature storage.

SUMMARY AND CONCLUSION

Papaya nectar was prepared and stored at room temperature (29°—31°C) and at refrigerated temperature (4°—5°C). The effects of various packaging conditions and additives on the rate of color change of the stored juices were studied by measuring for a period of 1 year the color density of the samples at regular 2-month intervals.

Room temperature storage, in general, favored browning of papaya nectar. The type of container and light did not have any appreciable effect on the rate of darkening of the sample stored at room temperature. The presence of oxygen in partially filled bottles would possibly have accelerated color darkening. Added amino compound (glutamic acid) accelerated the rate of darkening of the samples at both room and refrigerated temperature storage. Ascorbic acid caused lightening of color at low temperature storage. At room temperature,

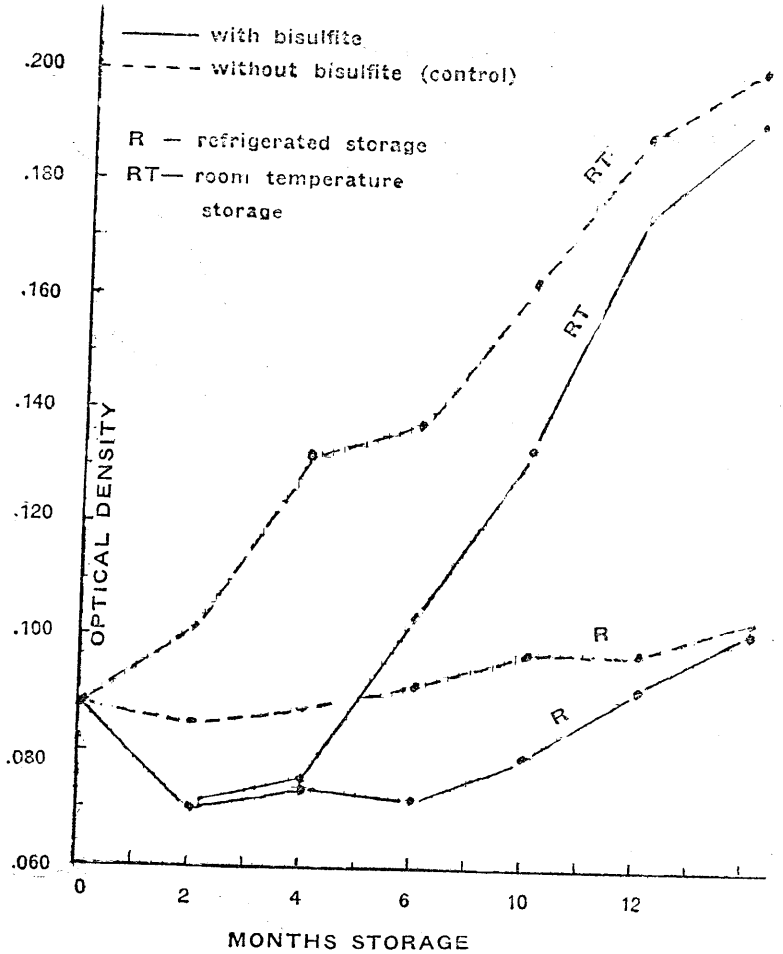

FIG. 3. Color changes in stored papaya nectar treated with potassium metabisulfite and corresponding control.

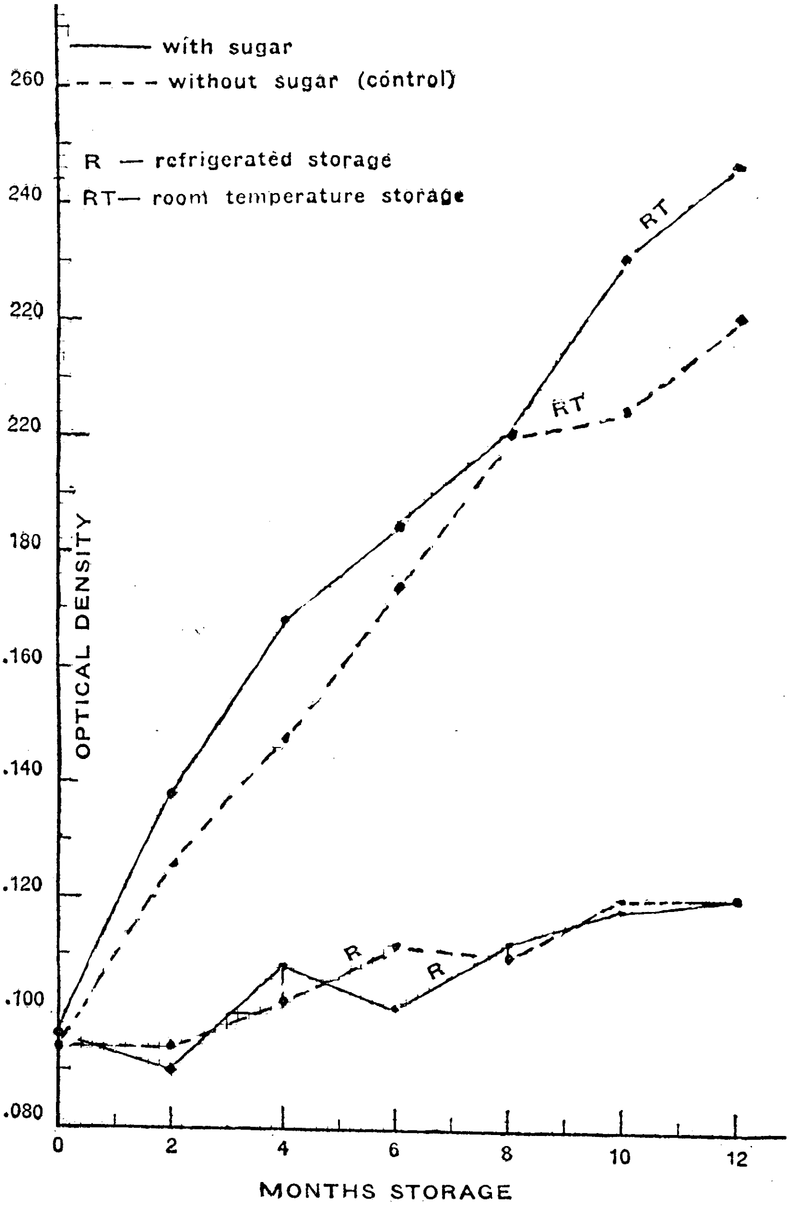

FIG. 4. Color changes in stored papaya nectar with and without added sugar.

its effect is slightly offset. Added bisulfite caused temporary bleaching at both storage temperatures. The bleaching action takes place and reaches completion rapidly. The presence of sugar did not affect the rate of color change at low temperature storage. However, added sugar caused a faster rate of darkening at room temperature.

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PREPARATION OF BANANA FLAKES FROM LAKATAN (MUSA SAPIENTUM LINN. VAR. LACATAN)

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INTRODUCTION

Banana with its natural flavor can be prepared into a dehydrated product. Since banana is a widely accepted fruit even in foreign countries, it can be fairly assumed that banana in a highly acceptable processed form would also meet favorable acceptance in foreign markets.

There is very high standing demand for powdered tropical fruits in Europe and the United States. According to the report of the General Fruit Corporation of the Philippines(1) it would be possible to export up to 20,000 tons of banana in powdered or flake form to foreign markets.

A continuing interest in dried banana product has led investigators to work on dehydration by different methods in the search for improvement over the conventional sun-drying method which has been used for many years in the tropics. Several studies on dehydration of different fruits by drum drying have been reported.(5, 7, 9, 13, 17) Banana powder produced by drum drying has attracted more attention from commercial farm processors than other dried banana products. Bundus et al(6) made a study on the preparation of banana flakes with less than 4-per cent moisture and containing no additive which was produced by the pulping, pasteurizing, and rapid drying of fresh bananas. In Israel, a recent work was reported on the production of dehydrated flakes as a means of utilizing surplus bananas.(13) A commercial company in Ecuador, the world's leading banana-producing country manufactures banana flakes from their "tropic-ripened" bananas. It is used in baby foods, as ingredient for bakery mixes, icings, confection, and ice cream.(3)

There is at present no reported study on the preparation of banana flakes from local banana varieties. The purpose of this study, therefore, is to prepare banana flakes from *lakatan* (*Musa sapientum* Linn var. *lacatan*) with maximum retention of its natural flavor, color, and aroma. *Lakatan* was chosen

for the investigation because of its attractive golden yellow color and strong characteristic flavor and aroma. It is also widely available in the country.

MATERIALS AND METHODS

Experimental procedure.—Ripe *lakatan* bananas were purchased from local markets around the city of Manila. Different formulation and drying conditions were tried in the preparation of banana flakes before an acceptable product was obtained.

The following procedure was followed in this study.—Fully ripe, sound bananas were thoroughly washed with water. The fruits were peeled and sliced thinly. The sliced fruits were pureed in a Waring blendor with an equal amount of water containing sodium metabisulfite at a concentration of 2,000 ppm. The slurry was strained through nylon mesh to remove the black abortive seeds which are found embedded in the middle of the ripe fruits.

The following ingredients were added to every 100 grams of the slurry: 2 grams gelatinized corn starch, 3 grams sugar, and approximately 0.2-gram sodium bicarbonate (sufficient to raise the pH of the mixture to pH 5). The mixture was then fed to the trough of a steam-heated double drum drier with drums spaced 0.003 inch apart. The steam pressure in the drum was 80 pounds per square inch gauge at a temperature of 162°C. At a drum speed of 2 rpm the product is in contact with the heated surface of the drum for 15 seconds. The dried material was removed as thin sheets of flakes from the drum surface by doctor blades. These flakes were packed in plain (No. 2) tin cans and sealed hermetically.

Examination of banana flakes.—The following examinations were made on the banana flakes every month for 6 consecutive months: moisture using the conventional AOAC method,(2) sulfur dioxide content using a rapid simplified method by Ponting and Johnson.(11) The color of the alcoholic extract of banana flakes was measured with a Klett Summerson photoelectric colorimeter using filter No. 42 which has an spectral range of 400 to 465 mμ.(4)

Evaluation of palatability and physical appearance of the banana flakes during the 6-month storage period was undertaken by a panel of tasters of the Family Nutrition Branch,

Medical and Applied Nutrition Division of the Food and Nutrition Research Center. Six panel members rated the samples using the following scoring method approved by the Technical Committee of the Food and Nutrition Research Center and the Office of Statistical Coordination and Standards (OSCAS) No. 56–R 115:–10–9 desirable; 8–7 acceptable; 6–5 neutral (neither like or dislike); 4–3 objectionable; 2–1 unacceptable. Single classification of analysis of variance was used in the statistical evaluation of the data of the panel members.

RESULTS AND DISCUSSION

Table 1 shows the physical and chemical properties of the banana flakes prepared from *lakatan* during the 6-month storage period at room temperature (29° to 31°C).

TABLE 1.—*Physical and chemical properties of banana flakes from lacatan (Musa sapientum Linn. var. lacatan) during storage for 6 months at room temperature.*

Storage period	Moisture	Color O.D.	SO_2
months	*Per cent*		*ppm*
1	2.23	0.256	49.25
2	2.28	0.266	49.21
3	2.64	0.280	47.77
4	2.28	0.308	48.12
5	2.60	0.340	48.38
6	2.55	0.446	48.30

The moisture content of the banana flakes remained practically constant during the 6-month storage ranging from 2.23 to 2.64 per cent. This may be attributed to the fact that they were packed in hermetically sealed cans. Brekke and Allen's (5) study on dehydrated banana flakes showed that products containing 3.5-per cent moisture tend to cake while those below 3 per cent remain free flowing. Too low a moisture content had an adverse effect on the flakes. When the moisture fell below 2 per cent, the flakes had a scorched taste and reduced storage stability. (14)

The SO_2 content of the banana flakes did not change appreciably as shown in Table 1. The poor retention of SO_2 was due to volatilization and oxidation during drying. To maintain the desired qualities in dried fruit it has been found necessary to incorporate in it an excess of sulfur dioxide to allow for lossess occurring during drying, processing and storage.

The actual sulfur dioxide content needed will vary with the type of fruit, the final moisture content and storage condition.(8) Extensive data have been obtained on the various factors involved in SO_2 absorption and retention and on the factors that determine the role of SO_2 in inhibiting browning as reported by Long et al.(10)

The rate of color change of the banana flakes increased proportionally with increase in storage time as shown in Table 1. The color value increased from 0.256 to 0.446 during the 6-month storage period. The time required for a given color development varies exponentially with the absolute temperature if the moisture content is constant, or with the moisture content at constant temperature.(12) The change in color may also be attributed to sugar-amino acid reaction known as Maillard reaction.

Table 2 shows the analysis of variance of the sensory scores of the banana flakes stored at room temperature for a period of 6 months. There was no significant difference in acceptability at 1-per cent level during the whole period of study.

TABLE 2.—*Analysis of variance of sensory scores for the storage values of banana flakes.*

	d.f.	SSS	MSS	F
Between storage Period	5	20.47	4.10	3.23
Error	30	38.00	1.27	
Total	35	58.47		

The sulfured drum-dried flakes were golden yellow in color and flaky in texture and still acceptable even after 6 months storage.

SUMMARY AND CONCLUSION

Banana flakes were prepared from *lakatan*. Ripe sound bananas were made into puree, and sodium metabisulfite with other ingredients were added. The mixture was dried in the double drum drier with the drums spaced 0.003 inch apart, with a steam pressure of 80 pounds per square inch gauge and the drums rotating at 2 rpm. The product was packed in plain No. 2 tin cans, sealed hermetically and stored at room temperature for 6 months. Periodic determinations of moisture, sulfur dioxide, color and acceptability in terms of flavor and eye appeal were made.

The moisture content remained constant during storage but there was a slight change in the color of the flakes. There was no significance difference in acceptability at 1-per cent level during the whole period of study, and the products were still acceptable at the end of 6 months.

From the above study it may be concluded that banana flakes, with maximum retention of its natural flavor and aroma can be prepared from *lakatan* variety.

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THIAMINASE IN SOME SPECIES OF FISH, CLAMS, AND CRUSTACEANS IN THE PHILIPPINES

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A disease of foxes known as Chastek paralysis was first reported by Green and his associates(6) as due to thiamine deficiency produced when raw carp was included in the ration of these foxes. This disease was later found out to be an unusual type of avitaminosis which results from the destruction of dietary thiamine prior to absorption from the gut. The antithiamine factor responsible for the destruction was then shown to be a hydrolytic enzyme called thiaminase. This enzyme splits thiamine into pyrimidine and thiazole moieties and destroys thiamine by a reaction in which the thiazole unit is replaced by other bases in fish tissues.(5)

Antithiamine activity in certain species of fish has aroused the interest of many investigators. Deuthsch and Hasler(4) observed the presence of the enzyme in 15 of the 31 fresh-water fish tested, and its absence in nine salt-water species. Bhagvat and Devi(1) reported the existence of the antithiamine factor in carp. Deolalkar and Sohonie(3) showed the occurrence of the enzyme in 28 varieties of Indian fish. Jacobson and Azevedo(8) found thiaminase in shrimps and some mussels. Twenty-one of the 30 species listed by Hilker and Peter(7) also exhibited antithiamine activity.

The practice of eating raw or partially cooked fish is observed among some Filipinos especially those who live in the coastal regions. Different methods of food preparation like marinating with vinegar or *kalamansi,* boiling, salting, etc. are often employed. This study therefore was conducted to determine the presence of thiaminase in some varieties of local fish, clams, and crustaceans that are commonly eaten raw or partially cooked. The effect of some methods of preparation on the thiaminase activity was also studied.

SAMPLING AND METHOD OF PREPARATION

The samples used included eight varieties of fish, five clams, and four crustaceans which were bought from the open market.

Of the eight varieties of fish tested five were salt-water fishes, two were fresh-water fishes and one belonged to the brackish-water species. Sampling was done either by quartering or geometric method of AOAC(2) depending upon the size of the samples.

Fish samples were first cleaned, scaled, and eviscerated. In the case of small fish like *dilis,* sampling included the head. For the large ones, three transverse slices (one-inch thick) were cut from at least three fishes, one slice from immediately back of the pectoral fin, one slice halfway between the first slice and vent and one slice immediate back of vent. The bones and fins were separated. Representative aliquots were obtained and minced.

Clams and crustaceans were likewise washed to remove all silt and dirt and then drained well. The edible portion was collected in a clean dry container to yield at least 1 pound of drained meat.

ANALYTICAL METHOD

Five 50-gram portions of each sample were weighed and treated as follows:

a. Raw. Weigh 50-gm sample from the lot obtained in the sampling.
b. Boiled. To another 50-gm sample add 50 ml of water and boil for 5 minutes.

c. Marinated A. Macerate 50-gm sample three times with 30 ml portions of del Monte vinegar and drain after each maceration. Marinate with another 30-ml portion of vinegar plus a pinch of salt to taste and let stand for one hour. Drain in a cheese cloth folded four times with light squeezing.

d. Marinated B. Follow the same procedure as above but use *kalamansi* juice instead of del Monte vinegar.

e. Salted. To 100-gm sample add 33-gm salt, mix thoroughly with a spatula and cover with a plastic cap. Store at room temperature and analyze after at least three months storage.

Transfer each of the above samples into the cup of a waring blendor, add sufficient quantity of water to make a total weight of 150 gm and homogenize for 1 minute. Weigh two portions of a calculated amount of the slurry (equivalent to 10-gm sample), add enough water and take the pH. Adjust the pH of the contents of the second portion to pH 4.5 (control) and heat in a boiling water bath for 20 minutes. This second portion for all the different treatments served as the control. Cool and bring pH to original. Add 40-mcg standard thiamine

hydrochloride and toluene to serve as preservative to both flasks and incubate the mixture at 37°C overnight. At the termination of the incubation period cool to room temperature and filter, collecting the filtrate in a 100-ml graduated cylinder. Thiamine is then determined in a measured aliquot of the filtrate using the method of Conner and Straub.(2) The amount of thiamine destroyed is taken as a measure of thiaminase activity.

RESULTS AND DISCUSSION

The antithiamine activity of the fish, clams, and crustaceans analyzed is shown in Table 1. Results show the presence of antithiamine activity in all the species of fish investigated. Variation in thiaminase activity indicates that the diet and habitat of the fish, clams, and crustaceans may be determining factors for the presence of thiaminase. Complete or almost complete destruction of the added thiamine was shown in 9 out of 17 species studied, 3 fell within the 40- to 80-per cent destruction ranging from 16 to 37 per cent. The data further showed the abundance of the enzyme in raw crustaceans rather than the fish species since the per cent destruction was complete or nearly so in "alimango," "alimasag," "talangka" and "hipon." With regard to the five varieties of raw clams tested, "kanturi," "tulya," and "halaan" quite appreciably exhibited the enzyme activity as exemplified by their corresponding percentage of destruction. "Balay" contained the enzyme only in a very small amount. A separate analyses of the tail showed also the presence of the enzyme. For "talaba" the finding was quite perplexing. Thiamine recovery was more than 100 per cent so that the activity was designated to be negative. It is not unlikely that there exists in "talaba" a kind of enzyme which synthesizes thiamine; or, the added thiamine in the sample may have resulted in some bacterial action which resulted in thiamine synthesis. This is a problem which can be the subject of another investigation.

Boiling the sample for 5 minutes generally decreased the enzyme activity to a considerable extent as was the case in boiled "bangus," "dilis," "dulong," "talakitok," etc. But not all enzyme can be destroyed by heating; probably because of the presence of a thermostable thiaminase factor in some of the samples analyzed; namely, "dilis," "alimasag," and "halaan."

TABLE 1.—*Thiaminase activity of fish, clams, and crustaceans.*

Local name	Scientific name	English name	Percentage destruction of thiamine									
			Raw		Boiled		Salted		Marinated A		Marinated B	
			Uh *	H *	Uh	H	Uh	H	Uh	H	Uh	H
FISHES												
Bangos	*Chanos chanos*	Milkfish	70.00	1.50	11.00	10.00	** 91.25	76.65	0	3.00	65.00	11.50
Dilis	*Stolephorus commersoni*	Anchovy	98.15	41.25	98.15	29.00	99.60	88.25	60.85	0	42.75	0
Dulong	*Migrogobius locustris*	Gobies	54.12	24.50	12.55	22.75	95.75	89.25	1.75	13.75	1.75	6.25
Karpa	*Cyprinus carpio*	Carp	98.75	35.00	10.00	6.88	99.38	54.38	98.75	31.25	91.25	10.00
Talakitok	*Caranx sexfasciatus*	Cavalla	77.30	3.60	13.75	4.25	83.00	70.75	0	0	0	0
Tambakol	*Neothunus macropterus*	Yellow fin tuna	18.12	1.12	5.62	0	91.50	83.50	69.38	54.56	53.75	11.88
Tanige	*Scomberonous commerson*	Spanish meckerel	31.25	1.90	44.00	4.75	94.75	95.75	33.00	1.90	0	0
Tulingan	*Auxis thazard*	Tuna, bonito	36.50	0.25	40.60	14.38	95.25	91.75	22.00	0	0	0
CLAMS												
Balay **	*Lingula unguis*	Tongue clam	16.25	6.75	7.75	7.50	89.75	85.62	15.20	7.45	22.25	4.75
Halaan	*Cyraeidae*	Clam	100.00	41.25	91.88	35.62	91.75	53.75	100.00	15.62	98.12	13.75
Kanturi	*Venus* spp.	Clam	100.00	80.00	65.62	58.75	100.00	61.88	97.50	56.25	100.00	55.00
Talaba	*Ostrea* sp.	Oyster	100.00	100.00	30.00	19.38	61.48	98.12	100.00	8.75	43.12	6.88
Tuiya	*Cyrenidae*	Clam	99.00	7.50	50.00	5.00	97.75	85.25	99.00	5.60	99.00	0
CRUSTACEANS												
Alimango	*Scylla serrata*	Crab	99.38	43.75	67.50	19.38	54.38	65.00	15.62	16.25	35.00	11.88
Alimasag	*Neptunus pelagicus*	Blue-crab	99.38	30.00	98.12	10.62	99.38	64.38	98.88	1.88	99.38	67.50
Hipon (Suahe)	*Meta peracus*	Shrimp	99.50	23.25	63.50	28.80	** 89.75	74.25	0	0	12.75	0
Talangka	*Potamon grapsoides*	Small crab	100.00	96.25	81.00	100.00	** 91.75	64.05	100.00	97.25	99.00	47.50

* Uh, unheated extracts; H, extracts heated at 100 °c for 20 minutes.
** Aliquots analyzed contained only 5 grams of fish.

Results of the analysis of the salted portions generally showed an increase in thiaminase activity compared to those originally present in the raw samples. This seemed to indicate that salt has a preserving and activating action for the enzyme. Hence, the increase of thiaminase in some samples after incubation. The sodium ions may also affect the activity of the enzyme as found by McElroy and Nason.(9) These authors postulated that sodium ions may act as an essential activiting ion for specific enzyme system. It is known that the concentration of inorganic ions in the tissues of marine invertebrates (lobster, crabs, crayfish) is relatively low and may not be enough to activate the enzyme. However, the addition of salt increases the level of the activating ions which might have affected the thiaminase enzyme system.

Specific points considered before analyses of the marinated portions were as follows: (*a*) During marinating with either *kalamansi* or vinegar, a pinch of salt was added to simulate the method done in the household. It would have been better if the lone effect of either marinating solution was also determined separately from salt to find their real effect, if any, on the enzyme. Salt, as has been previously discussed, in the salted portions may have also exerted the same activating action on the extracts even if added in small amounts; (*b*) the solution after each treatment (done three times) were all discarded. A parallel determination wherein the extract after marinating was included yielded more enzyme activity than when the extract was discarded. It is therefore safe to assume that the enzyme is easily extracted in dilute salt solution. These properties, coupled with rapid destruction by heat and the precipitation by common protein precipitants indicate the enzyme to be protein in nature.(6)

Both marinating solutions were found to be effective in inactivating the enzyme present in "talakitok," "tanguige," "alimango," and "hipon." The data presented further showed that complete destruction of thiamine was shown in marinated "tulya," "kanturi," "halaan," "talangka," "alimasag," and "karpa." The thiaminase present in those species may be so appreciably high that the amount of marinating solution or the number of treatments with vinegar and *kalamansi* juice was not sufficient to render the enzyme inactive.

The biochemical role of the ingestion of fish containing antithiamine activity should be further studied. Melnick et al(10)

demonstrated that more than eight times the minimmum requirement for thiamine (8 mg) for human subjects was destroyed in 20 minutes by one serving of raw clams (100 gm). They further noted that about 50-per cent destruction of thiamine occurred in the gut following the concomitant ingestion of raw clams. Some Filipinos especially those living in the coastal regions are very fond of eating raw, marinated, salted, or fermented fishes such as "bagoong." We oftentimes find "patis," a by-product of processed fish, as a common condiment. It is possible that the thiamine intake is much impaired due to the presence of this thiamine-destroying enzyme.

Since the presence of the enzyme has been confirmed by the foregoing investigation the authors feel it expedient to recommend a study involving a greater number of samples of the different varieties of local fish, clams, and crustaceans. This study should also include some popular fish products and by-products like "tinapa," "daing," "tuyo," "buro," "bagoong," and "patis" which are commonly eaten in the Filipino household. A more elaborate consideration of the presence of the enzyme might justify subsequent reassessment of the thiamine requirement in our Recommended Daily Allowances.

SUMMARY

The presence of thiaminase was determined on eight varieties of fish, five clams, and four crustaceans by an indirect method. A known amount of standard thiamine hydrochloride was added to each sample and the per cent recovery determined by the modified thiochrome method. The amount of thiamine destroyed was taken as a measure of thiaminase activity.

All varieties of raw fish tested exhibited antithiamine activity although the presence of the enzyme was most pronounced in the species of crustaceans tested.

Boiling and subsequent storage for 3 months increased thiaminase activity which indicated the preserving and/or activating action of salt on the enzyme.

No definite conclusion can be made to assess the relative efficiency of the two marinating solutions used although results indicated that the nature of the marinating solution affects the thiamine activity of each sample tested.

A more elaborate study of the enzyme on local fish and fish products is indicated.

ACKNOWLEDGMENT

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UVARIA RUFA BLUME

A PRELIMINARY REPORT ON ITS CONSTITUENTS *

By ALFREDO C. SANTOS,[1,2] MODESTO T. CHUA,[3] NATIVIDAD EUFEMIO [1] and JULIETA R. LIBREA [2]

ONE TEXT FIGURE

Uvaria rufa Blume (Tag. hilagak, susong kalabau) of the family Anonaceæ is a climbing shrub often 5 to 6 meters high and is widely distributed in the Philippines at low and medium altitudes.(4, 6) Many members of the family Anonaceæ have now been thoroughly investigated chemically. The publications have dealt mainly with the isolation and the determination of the chemical structure of their alkaloids. A literature survey on the occurrence of alkaloids in the anonaceous plants has been covered by Librea.(3) A review of the chemical constituents of these plants is presented in Hegnauer's work.(2) Representatives of the benzylisoquinoline precursor, and of the derived types aporphine, protoberberine and bisbenzyl-isoquinoline have been found in plants belonging to the family Anonaceæ. From the chemotaxonomic point of view, the study of the other secondary constituents is equally interesting. Very little is known about the non-nitrogenous constituents of the anonaceous plants. A neutral principle called anonol was isolated from the bark of *Anona muricata* L. by Power and Salway,(5) as a white compound with melting point 294–298° and a molecular formula $C_{23}H_{36}O_2(OH)_2$.

Uvaria rufa Blume is a very interesting material for chemical study. Aside from some qualitative tests for alkaloids by Espino,(1) which gave positive results there seems to be no record of a thorough chemical study of this plant in the literature. A study of both alkaloids and the non-nitrogenous constituents of *Uvaria rufa* Blume is therefore being undertaken by the present authors. In this paper we are presenting a preliminary report on the non-nitrogenous constituents of the plant.

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CONSTITUENTS OF THE STEM BARK

For orientation purposes the stem bark of *Uvaria rufa* Blume as extracted with hexane in a Soxhlet apparatus. After three days the extraction was complete. TLC[4] run at this stage indicated the presence of at least two spots.[5] The following outline shows the subsequent treatment of the hexane extract:

Uvaria rufa Blume (stem bark, powdered, 150 gm)

Extracted with 1,200 ml hexane[6] the solvent replaced each day, for three days; combined hexane extracts concentrated fractionally *in vacuo*, set aside in a cold room (10°) until crystallization begins; the process repeated reducing the volume by ¼ each time.

Hexane extract		Description of crops[7]	m.p.[8]	Quantity
H–1	(green)	Negligible	—	—
H–2	do	Crystalline, pale brown	108–111°	0.295 gm
H–3	do	very little, not uniform	—	—
H–4	do	crystalline, yellowish brown	102–108°	0.023 gm
H–5	do	crystalline, yellowish brown	105–148°	0.006 gm
H–6	(last); dark green syrup	crystalline, white	228–231°	traces

With the above indications the extraction in large quantities was next undertaken. For this purpose 15 kilos of the stem bark were extracted in a Lloyd Extractor[9] with hexane at 50° and the solvent recovered in vacuum. The following crops were obtained:

[4] The spreader of 275μ thickness was constructed at the NIST, Section of Fine Mechanics through kindness of Mr. Hakansson.

[5] Adsorbent: Kiesselgel G; Solvent Systems: ethyl acetate + benzol (2:3); chloroform + acetone (4:1).

[6] Esso brand, redistilled.

[7] Crops from H–1 to H–5 were washed with ethanol; H–6 with benzol, till white.

[8] Kofler type hot stage was constructed at the Ateneo de Manila University through courtesy of Professor Modesto Chua, and the temperature regulator made at the NIST, Electronics Division, through the kindness of Messrs. Alonte and Juan.

[9] At the NIST, Pilot Plant through courtesy of Director Santillan and Miss Capiral.

Hexane fractions		Quantity
H-1 [10]		25.580 g
H-2		10.536
H-3		2.426
H-4		2.551
H-5	Thick, green-colored liquid depositing white, shinning plates on standing in a shallow dish at room temperature.	

Crops H-1 to H-4 were mixtures of green tainted crystals, melting over a wide range of temperature. We are now working on the separation of the constituents of these fractions. For the time being we will report on the isolation of a crystalline compound from the last hexane mother liquor (H-5).

Isolation of compound C.—The thick dark green-colored hexane mother liquor (H-5) which did not give crystalline deposit anymore on long standing in the refrigerated room (t = 10°) was allowed to evaporate spontaneously before an electric fan at room temperature. After many weeks standing, beautiful white plates began to deposit at the bottom of the flat Pyrex dish. They were separated by decantation from time to time, transferred to a Hirsch funnel and washed with benzol until the greenish tint disappeared. The crude crystals consisted of a mixture of compound C (R_f ca. 0.5 in Chlf. + Pet Ether (9:1) and a tailing impurity, which disappears when well washed with benzol; in this way the melting point rises to as high as ca. 232 to 236°, but the yield decreases also considerably. We thus obtained the following crops, all showing only one spot in the TLC:

	Original crops		Crops from mother liquors	
	m.p.	*Quantity*	*m.p.*	*Quantity*
H-5-1	232–236°	0.537 gm	221–229°	0.392 gm
H-5-2	224–226°	1.323	212–221°	0.819
H-5-3	228–229°	0.210	226–228°	0.048
		2.070 gm		1.259 gm

Total yield of crude compound C = 3.329 gm (0.022 per cent of the stem bark).

Purification of compound C, m.p. 239 to 340°.—0.595 gm of the crude crystals which showed one spot only in the TLC were chromatographed in a column of silica gel and fractions collected as follows:

[10] Volume of hexane extract; about 11 liters.

Fraction No.	ml	Rf	Remarks
1	19	—	No residue
2	4	—	Very light residue
3	4	—	Light residue
4	4	0.51	Heavy residue
5	4	0.49	
6	4	0.48	
7	4	0.52	
8	4	0.53	
9	4	0.53	
10	4	0.54	
11	4	0.53	
12–17	4 each	—	

Fractions 4 to 11 were combined and evaporated spontaneously before an electric fan. The residue was taken up in a chloroform + petroleum ether (9:1) mixture, and absolute methanol. or ethanol carefully added to beginnning cloudiness. After a while there was a separation of shining white plates with a melting point of 239 to 240°. Yield = 0.207 gm.

An elementary analysis of the crystals dried in high vacuum at ordinary temperature gave: C 85.3 per cent, H. 11.33 per cent, and 3.33 per cent (total 99.96 per cent) indicated that the compound is not nitrogenated.[11] An IR spectrum (In KBr, and in CCl_4) showed: 1708 cm^{-1} (C = 0, 2970, 2860 (V CH of CH_2, CH_3), 1379, 1445 cm^{-1} (dCH of CH_2, CH_3) Fig. 1. Structural analysis of compound C on the basis of MS and NMR data will be reported in a subsequent report.

SUMMARY

Compound C, m.p. 239–240°, has been isolated from the stem bark of *Uvaria rufa* Blume. It is chromatographically uniform, contains 85.3-per cent carbon, 11.33-per cent hydrogen and 3.33-per cent oxygen, and shows in the IR, bands at 1708 cm^{-1} (C = 0), 2970, 2860, 1379, 1445 cm^{-1} (CH_2, CH_3). Indications point to a triterpene.

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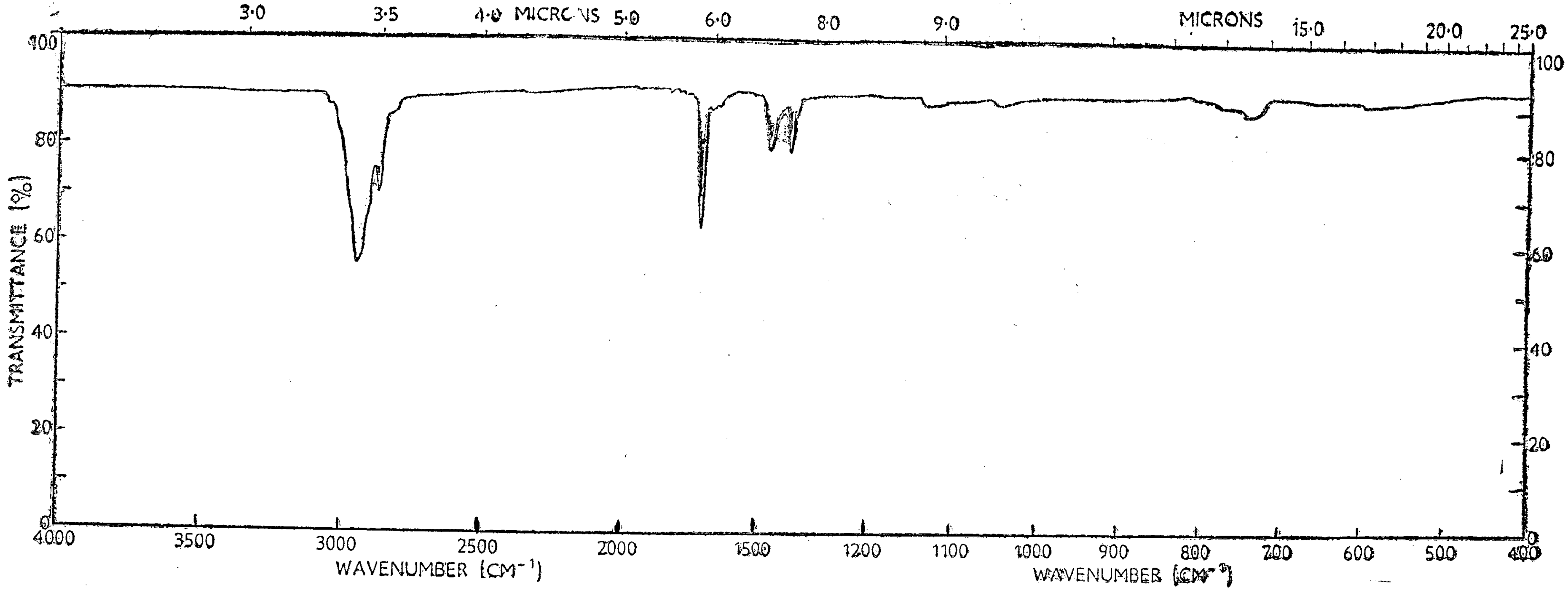

FIG. 1. IR spectrum of compound C(KBr.)

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THE ECHINODERM FAUNA OF MANILA BAY *

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INTRODUCTION

The survey of Manila Bay, after World War II, was participated jointly by the Republic of the Philippines and the United States. During the survey, it has been observed that many of the echinoderms were brought up to the surface of the sea with the fish catch by the use of otter trawl fishing net. Captain Ziesenhenne, after the fisheries program, resumed his work in the Allan Hancock Foundation and managed the Marine Floating Laboratory of the Foundation. There, he classified and identified his collections of the echinoderms from Manila Bay, but apparently nothing has been published.

The senior author was inspired with the work done by Captain Ziesenhenne and as adviser to the graduate school of the University of Santo Tomas, for students preparing their master's theses, he assigned this study to the junior author.

Arrangement has been made with some operators of the otter trawls operating in Manila Bay and with some personnel of the former Bureau of Fisheries to gather representative samples of the echinoderms brought up to the surface by the otter trawl fishing nets. For all purposes the otter trawl is mainly dragged over the ocean bed, most often close to the ground floor of the sea, bagging with it aquatic benthos of indiscriminate species. It is from this indiscriminate marine life, mostly fishes, from where the echinoderms described in this paper were collected.

* This work is a dissertation from the thesis of the junior author in partial fulfilment of her Master of Science degree in Zoology, University of Santo Tomas, Manila.

TAXONOMIC LIST OF ECHINODERMS DESCRIBED

CLASS ASTEROIDEA

Order PHANEROZONIA

Family LUIDIIDÆ

Genus LUIDIA Forbes

1. *Luidia longispina* Sladen
2. *L. maculata* Muller & Troschel

Order SPINULOSA

Family PTERASTERIDÆ

Genus PTERASTER Muller & Troschel

3. *Pteraster trigonodon* Fisher var. *philippinensis* nov. var.

CLASS ECHINOIDEA

Order CENTRECHINOIDEA

Family DIADEMATIDÆ

Genus DIADEMA Mortensen

4. *Diadema setosum* Leske

Genus ECHINOTRIX Peters

5. *Echinotrix calamaris* (Pallas)

Genus ASTROPYGA Gray

6. *Astropyga radiata* (Leske)

Family ARBACIIDÆ

Genus ARBACIA

7. *Arbacia incisa* (Agassiz)

CLASS OPHIURIOIDEA

Order CHILOPHIUROIDEA

Family OPHIOLEPIDIDÆ

Genus OPHIURA Lamarck

8. *Ophiura* sp., probably a new species

Genus OPHIOLEPIS Muller & Troschel

9. *Ophiolepis cincta* Muller & Troschel

Family OPHIODERMATIDÆ

Genus OPHIARACHNELLA Ljungman

10. *Ophiarachnella gorgonia* Muller & Troschel

CLASS HOLOTHURIOIDEA

Subclass ASPIDOCHIROTACEA Grube

Order ASPIDOCHIROTIDA Grube

Family ACTINOPYGIDÆ

Genus ACTINOPYGA Bronn

11. *Actinopyga echinites* (Jaeger)

Family MERTENSIOTHURIIDÆ

Genus MERTENSIOTHURIA Deichmann

12. *Mertensiothuria brauni* (Helfer)
13. *M. curiosa* (Ludwig)

Family BRANDTOTHURIIDÆ

Genus BRANDTOTHURIA Deichmann

14. *Brandtothuria impatiens* (Forskal)

Family FOSSOTHURIIDÆ

Genus FOSSOTHURIA Deichmann

15. *Fossothuria scabra* (Jaeger)

Family LESSONOTHURIIDÆ

Genus LUDWIGOTHURIA Deichmann

16. *Lessonothuria pardalis* (Selenka)

Family LUDWIGOTHURIDÆ Deichmann

Genus LUDWIGOTHURIA Deichmann

17. *Ludwigothuria atra* (Jaeger)

Order MOLPADONIA

Family MOLPADIIDÆ

Genus PARAGAUDINA Heding

18. *Paracaudina australis* (Semper)
19. *P. aspiculata* sp. nov.

Order APODIDA Brandt

Family CHIRIDOTIDÆ

Genus CHIRIDOTA Eschscholtz

20. *Chiridota rigida* Semper

Key to the species of Luidia

A. Arm rays five; paxillæ 15 to 20 of peripheral slender spinelets distinctly spaced except along the median area of ray; infero-marginal armature with single conspicuous lateral spines; two-jawed pedicellariæ .... *longispina*

B. Arm rays eight; paxillæ 7 to 18 blunt, subtruncate peripheral spinelets; paxillæ of lateral rows roundish quadrate; infero-marginal spines proximally four; pedicellariæ absent .... *maculata*

LUIDIA LONGISPINA Sladen.

Luidia longispina SLADEN (1889).

With five arms; R, 63 mm; r, 9 mm; R, 7r. Dorsolateral crown of paxillæ arranged in regular series on each ray. Paxillæ silghtly spaced, the larger having 15 to 20 slender spinelets, the smaller paxillæ vary greatly according to their position. Anus and madreporite very minute, hardly visible, apparently none. Arms flexible, easily broken off or detached Adambulacral spines minute; tube feet arranged into rows.

Color of specimen: light gray in preserved state.

Locality: Northern Corregidor, Manila Bay. Found on fine sand or mud, 18 to 24 fathoms deep.

LUIDIA MACULATA Muller and Troschel

Luidia maculata MULLER & TROSCHEL (1842); PERRIER (1875); Koehler (1895, 1910b).

With eight arms; R, 225 mm. Some rays shorter than the longest one; diameter of base of arm 22 mm. Disk and arms consist of paxillæ differing from shape and number of spinelets. Paxillæ of arm 5 to 6 regular series on either side, squarish crown with 12 to 18 unequal, blunt, peripheral spinelets; between each series are smaller paxillæ not regularly arranged consisting of 7 to 12 shorter, subtruncate spinelets. Paxillæ on aboral central disk smaller and rounded with mostly 12 spinelets.

Tentacle scale present; adambulacral armature consisting of strongly compressed furrow spine followed by two large rows of tube feet.

Color of Specimen: In preserved specimen black and cream-white alternating.

Locality: Manla Bay, along Cavite side. Specimen taken from muddy bottom at a depth of 10.96 meters.

Genus PTERASTER M. and T.

Type species: *Pteraster trigonodan* Fisher

PTERASTER TRIGONODON var. PHILIPPINENSIS var. nov.

With five broad arms much recurved; R, 66 mm; r, 33 mm; R, 2r, form somewhat pentagonal. Paxillæ short and stout on aboral surface. Madreporite and anus not externally visible. Dorsal membrane thin, with numerous spiracles through which water enters. Seen from above disk evidently bounded by actinolateral membrane which projects in each interradius 2 mm. Oral surface somewhat flattened; actinolateral membrane forming a broad margin which decreases in width eventually from the interradial angle.

Adambulacral combs with 4 to 5 spines, usually 5 near the oral region in the new variety, with more than 5 in the straight typical species the outer one of each series comprises the longest spine. The number of spines composing the adambulacral combs is one of the main differences from the typical straight species. Another difference is the circle of five protuberances whch surround the spine in each pseudopaxilla as found in the straight typical species; in the new variety they are less in number. There are also some other minor differences.

Mouth plates rather narrow, each with a prominent or cenrtal elevation or boss for the large actinal or suboral spine. In the new variety the mouth is partly covered with more adam-

bulacral combs than the ambulacral grove, tentacle pores extending to aboral surface, supramarginal plates wanting, only few of the actinolateral spines visible from above.

Color: Dark grayish violet on adoral central and radial rays, lighter on oral and ambulacral groove.

Locality: Bataan side of Manila Bay. Bathymatrical range, 45.75 m. Buttom, muddy.

Key to the genera of Diadematidæ

I. Test subhemispherical, rigid:

A. Primary ambulacral tubercles large in 2 regular series; ambulacral primary spines long, not peculiar .... *Diadema*

B. Primary ambulacral tubercles small; aboral ambulacral primary spines very slender .... *Echinotrix*

II. Test low, more or less flattened, flexible in life; pore pairs on oral surface in 3 distinct areas .... *Astropyga*

DIADEMA SETOSUM (Leske).

Echinometra setosa LESKE (1778).
Diadema setosa GRAY (1825); ROXAS (1928).
Centrechinus setosus JACKSON (1912); CLARK (1921), (1946).
Diadema setosum MORTENSEN (1940).

Diameter of test, 25 to 65 mm; height of test, 9 to 28 mm; length of longest spines, 150 to 163 mm; diameter of anal system, 2 to 4 mm. Test regular, somewhat flattened with circular ambitus. Ambulacral plates compound; coronal plates more or less imbricate, peristome not plated; base of corona resorbed. Oculars small and each bears two or three miliary spines. Genital plate large, madreporite largest and most prominent.

Primary spines long, slender and the longest situated above ambitus. Secondary spines mostly distributed equally and absent in ambulacra. Miliary spines evenly distributed throughout. Primary and secondary spines fragile and halllow. Prmary tubercles perforate. Four rows at each poriferous area of the interambulacral and two rows in each interporiferous area of the interambulacral and two rows in each interporiferous area of ambulacra. Miliaries forming a more or less irregular line between the primary tubercles.

Venomous species and usually exposed in large groups in sandy-muddy bottom.

Color: Dark almost black aborally with dark banded slender spines.

Locality: Southern Corregidor, Manila Bay at a depth of 65.88 meters.

ECHINOTRIX CALAMARIS Peters.

Echinus calamaris PETERS (1774).
Echinotrix calamaris PETERS (1853); AGASSIZ (1872); DODERLEIN (1903); CLARK (1925), (1946); ROXAS (1928); MORTENSEN (1940).

Diameter of medium-sized test, 54 mm; height, 21 mm; D, 2.6 H; diameter of anal system, 8 mm; diameter of peristome, 25 mm; entire apical system, 15 mm. Test thin, flexible and flattened, sloping slowly toward ambitus. Middle abactinal ambulacral areas depressed. Anal tube conspicuous. Genital plates large, madreporite black, most conspicuous and of higher level than other genitals. Peristome slightly sunken in actinal surface, spaeridia and peristome gills present. Minute teeth arranged in separate whorls.

Abactinal interambulacra wide, ambulacrum narrower; ambulacral areas at actinal surface wider than at ambitus. Primary spines in the interambulacral areas, fragile and hollow. Secondary spines mostly in the ambulacral areas, smooth except at tip. Miliary spines scattered throughout. Pore pairs arranged in arches of threes.

Tubercles of primary spines in each interambulacrum below the region of ambitus perforate and arranged in 6 to 8 rows. Secondary tubercles also perforate forming 2 to 4 rows in the interporiferous areas of each ambulacrum.

Beautiful but venomous. When touched, tips of secondary spines break off easily and remain embedded with their poisonous secretion under the skin of the finger.

Color: Dark green with banded green spines, some with dark brown banded spines.

Locality: Southern Corregidor, Manila Bay. Usually found in a sandy region among coral rocks at a depth of 63.88 meters.

ASTROPYGA RADIATA (Leske).

Cidaris radiata LESKE (1778).
Astropyga radiata GRAY (1925); ROXAS (1928); MORTENSEN (1940); CLARK (1946).

Diameter of test, 47 to 120 mm; height of test, 20 to 50 mm; D, 2.5 H; length of longest spine, 40 mm; diameter of anal system, 5 to 15 mm; diameter of peristome, 37 to 59 mm. Test low, thin and soft; ambitus circular. Ambulacral areas narrower than interambulacral plates 10 or 11 in a column. Primary spines short, small and slender. Secondary spines situated on ambulacral areas. Miliary spines aggregated around primaries, numerous at actinal side of corona.

ECHINOTRIX CALAMARIS Peters.

Primary tubercles crenulate, usually in four rows. Secondary tubercles crenulated, arranged in two rows, twenty in number above ambitus. Two rows of pore pairs in interambulacrum, 10 to each row near margin of ambulacra.

General color: Reddish violet adoral with dark violet spines including oral sides.

Locality: Bataan side, Manila Bay. Usually found in green mud at a depth of 25.62 meters.

ARBACIA INCISA (A. Agassiz).

Echinocidaris incisa AGASSIZ (1863).
Arbacia incisa CLARK (1913).
Arbacia stellata MORTENSEN (1935).

Diameter of test, 45 to 60 mm; height, 21 to 30 mm; D, 2.14 H; length of longest spines, 51 mm; diameter of peristome, 15 to 25. Test somewhat globular, with circular ambitus; primary spines stout from base and tapering to a point, most numerous around ambitus. Primary spines stouter and longer than that of *Echinometra oblonga.* Secondary spines smaller and shorter, scattered all around abactinal and actinal sides. Miliary spines slender, fine and evenly distributed around primaries. Anus partly covered by miliary spines. Primary tubercle most numerous at abactinal region, miliary tubercles found throughout.

Color: Dark brown including primary spine on aboral side.

Locality: San Nicolas shoal, Manila Bay. Taken from a depth of 29.28 meters. One specimen taken from the supply canal of the Dagat-dagatan salt-water pond in Malabon, outside the Bay.

Key to the genera of Ophiolepididæ

A. Tentacle scales 3 or more, placed on both sides of pore, at least one basal arm segment; radial shield naked and swollen .... *Ophiura*
B. Tentacle scales two, more or less completely closing pore; radial shields separated proximally .... *Ophiolepis*

OPHIURA PANIZOI Domantay.

Disk of 6 mm diameter, circular flat but thick, pentagonal covered with imbricated and radial shields. Arms slender; length of arms twice the diameter of disk.

A large central plate on aboral surface surrounded by five radially arranged plates of about same size. A notch over base of arm bordered by two spines.

* Reported for the second time. Named after Rev. Fr. Alfredo Panizo, O.P., Dean, Graduate School, University of Sto. Tomas.

Oral surface composed of five pairs of mouth papillæ, the innermost spinelike. Mouth shields large, pear-shaped. Stem of pear forming a sharp angle pointing inward. Adoral shields narrow and meeting within. Genital opening originating between mouth shield and lateral mouth shields. Ventral arm plates short and well separated, proximal end produced to a point and convex distally. Arm spines 2½ times the length of arm joints. Ventral spines little longer than arm joints. Tentacle scales present.

Color of preserved specimen, yellowish above and lighter below.

Locality: San Nicolas shoal, Manila Bay , at a depth of 29.28 meters.

OPHIOLEPSIS CINCTA Muller and Troschel.

Ophiolepis cincta MULLER and TROSCHEL (1842); LUTKEN (1859); CLARK (1946); DOMANTAY and DOMANTAY (1966).
Ophiolepis garretti LYMAN (1865).

Diameter of disk, 10 mm; length of arm, 35 mm; width of arm at base, 3 mm; height, 2 mm; disk flat, covered with small imbricated overlapping plates, each surrounded by a row of single smaller, regularly arranged scales. Radial shields small, more or less concealed. Genital plates surrounded by a single row of small disk scales forming a five-edge-shaped margin. Aboral arm shields broad and distal margin with single row of scales. Arm spines not conspicuous from above. Arm interrupted with grayish and yellowish bands dorsally.

Oral surface with diamond-shaped mouth shields of uniform size. Adoral shields narrow, meeting within. With five pairs of mouth papillæ, outer, next narrower and inner one small. Genital opening beginning at mouth shields. With two flat tentacle scales. Oral arm shields quadrangular. Arm spines 3 to 4, white and short. Interbrachial areas below covered by overlapping plates having irregularly arranged small scales around plate, bigger above oral shields and smaller at the sides.

Color in life, greenish gray aborally and whitish orally.

Locality: Cavite side of Manila Bay. Taken from green sand among reef spots at a depth of 5.46 meters.

OPHIARACHNELLA GORGONIA (Muller and Troschel).

Ophiarachna gorgonia MULLER and TROSCHEL (1842).
Ophiarachnella gorgonia CLARK (1909a, 1921, 1946); DOMANTAY and DOMANTAY (1966).

Disk, 11 mm in diameter; length of longest arm, 49 mm. Aboral disk granulated with dark and light brown color. Light center disk granular, surrounded by darker ones. Arm banded with light and dark brown bands. With 10 to 11 flattened arm spines, lying close to lateral arm shields.

Oral disk granular, lighter than aboral. Eight pairs of mouth papillæ close to each other. Oral shields subtriangular with rounded corners. One flat tentacle scale close to arm spines. Four genital openings in each interbrachial space. Arm spines very conspicuous in both aboral and oral sides.

Color: In preserved specimen, dark brown aborally and lighter orally.

Locality: Bataan side of Manila Bay among sandy reefs at 27.45 meters deep.

Key to species of Holothurioidea described in this paper

A^1. Body subcylindrical, mouth and anus at both ends; 20 peltate tentacles.

a^1. Papillæ on dorsum smaller, pedicels on ventrum with conical tips, warty and scattered all over body. Skin rough to touch. Calcareos deposits buttons and tables.
Mertensiothuria brauni (Helper)

a^2. Papillæ dark brown, encircled with lighter ring at base. Pedicels on ventrum numerous, in five single rows but not very distinct. Calcareous deposits: irregular buttons and tables.
Mertensiothuria curiosa (Ludwig)

a^3. Papillæ scattered throughout body, encircled by light brown area. Papillæ on dorsum bigger with conical tips and warty bases. Integument rough to the touch. Calcareous deposits: large smooth buttons and large tables.
Brandtothuria impatients (Forskal)

a^4. Minute papillæ irregularly scattered over body. Calcareous deposits: buttons and tables with spiny projections.
Fossothuria scabra (Jaeger)

a^5. Dorsal brownish straw color with several black large spots usually in two rows, twelve or more to each row. Pedicels minute scattered all over body. Calcareous deposits: numerous irregular buttons and tables with spiny disk.
Lessonothuria pardalis (Selenka)

a^6. Papillæ and pedicels same all over body. Black coloration not faded in preserved specimen. Calcareous deposits: tables and rosettes intermixed .... *Ludwigothuria atra* (Jaeger)

A^2. Body quadrangular with dorsal papillæ and ventral pedicels distinct. Anal opening with 5 calcareous teeth. Integument thick and hardy. Calcareous deposits: numerous minute dichotomously branched rods and some simple rosettes.
Actinopyga echinites (Jaeger)

Oral surface composed of five pairs of mouth papillæ, the innermost spinelike. Mouth shields large, pear-shaped. Stem of pear forming a sharp angle pointing inward. Adoral shields narrow and meeting within. Genital opening originating between mouth shield and lateral mouth shields. Ventral arm plates short and well separated, proximal end produced to a point and convex distally. Arm spines 2½ times the length of arm joints. Ventral spines little longer than arm joints. Tentacle scales present.

Color of preserved specimen, yellowish above and lighter below.

Locality: San Nicolas shoal, Manila Bay , at a depth of 29.28 meters.

OPHIOLEPSIS CINCTA Muller and Troschel.

Ophiolepis cincta MULLER and TROSCHEL (1842); LUTKEN (1859); CLARK (1946); DOMANTAY and DOMANTAY (1966).
Ophiolepis garretti LYMAN (1865).

Diameter of disk, 10 mm; length of arm, 35 mm; width of arm at base, 3 mm; height, 2 mm; disk flat, covered with small imbricated overlapping plates, each surrounded by a row of single smaller, regularly arranged scales. Radial shields small, more or less concealed. Genital plates surrounded by a single row of small disk scales forming a five-edge-shaped margin. Aboral arm shields broad and distal margin with single row of scales. Arm spines not conspicuous from above. Arm interrupted with grayish and yellowish bands dorsally.

Oral surface with diamond-shaped mouth shields of uniform size. Adoral shields narrow, meeting within. With five pairs of mouth papillæ, outer, next narrower and inner one small. Genital opening beginning at mouth shields. With two flat tentacle scales. Oral arm shields quadrangular. Arm spines 3 to 4, white and short. Interbrachial areas below covered by overlapping plates having irregularly arranged small scales around plate, bigger above oral shields and smaller at the sides.

Color in life, greenish gray aborally and whitish orally.

Locality: Cavite side of Manila Bay. Taken from green sand among reef spots at a depth of 5.46 meters.

OPHIARACHNELLA GORGONIA (Muller and Troschel).

Ophiarachna gorgonia MULLER and TROSCHEL (1842).
Ophiarachnella gorgonia CLARK (1909a, 1921, 1946); DOMANTAY and DOMANTAY (1966).

Disk, 11 mm in diameter; length of longest arm, 49 mm. Aboral disk granulated with dark and light brown color. Light center disk granular, surrounded by darker ones. Arm banded with light and dark brown bands. With 10 to 11 flattened arm spines, lying close to lateral arm shields.

Oral disk granular, lighter than aboral. Eight pairs of mouth papillæ close to each other. Oral shields subtriangular with rounded corners. One flat tentacle scale close to arm spines. Four genital openings in each interbrachial space. Arm spines very conspicuous in both aboral and oral sides.

Color: In preserved specimen, dark brown aborally and lighter orally.

Locality: Bataan side of Manila Bay among sandy reefs at 27.45 meters deep.

Key to species of Holothurioidea described in this paper

A[1]. Body subcylindrical, mouth and anus at both ends; 20 peltate tentacles.

a[1]. Papillæ on dorsum smaller, pedicels on ventrum with conical tips, warty and scattered all over body. Skin rough to touch. Calcareos deposits buttons and tables.

Mertensiothuria brauni (Helper)

a[2]. Papillæ dark brown, encircled with lighter ring at base. Pedicels on ventrum numerous, in five single rows but not very distinct. Calcareous deposits: irregular buttons and tables.

Mertensiothuria curiosa (Ludwig)

a[3]. Papillæ scattered throughout body, encircled by light brown area. Papillæ on dorsum bigger with conical tips and warty bases. Integument rough to the touch. Calcareous deposits: large smooth buttons and large tables.

Brandtothuria impatients (Forskal)

a[4]. Minute papillæ irregularly scattered over body. Calcareous deposits: buttons and tables with spiny projections.

Fossothuria scabra (Jaeger)

a[5]. Dorsal brownish straw color with several black large spots usually in two rows, twelve or more to each row. Pedicels minute scattered all over body. Calcareous deposits: numerous irregular buttons and tables with spiny disk.

Lessonothuria pardalis (Selenka)

a[6]. Papillæ and pedicels same all over body. Black coloration not faded in preserved specimen. Calcareous deposits: tables and rosettes intermixed .... *Ludwigothuria atra* (Jaeger)

A[2]. Body quadrangular with dorsal papillæ and ventral pedicels distinct. Anal opening with 5 calcareous teeth. Integument thick and hardy. Calcareous deposits: numerous minute dichotomously branched rods and some simple rosettes.

Actinopyga echinites (Jaeger)

A³. Body short and plump, smooth, somewhat transparent, and slimy: posterior part more or less elongated forming a caudal end. With 14 to 15 short digitate tentacles. Calcareous deposits: irregular biscuit-shape with 2 to 8 perporations, somewhat spiny margin. *Paracaudina australis* (Semper)

A⁴. Similar to preceding, smaller and more transparent body wall. No calcareous deposits .... *Paracaudina apiculata* sp. nov.

A⁵. Body cylindrical, tapering toward posterior end. With 12 palmate tentacles, the two terminal ones large and long. Calcareous deposits: numerous wheels with six spokes, some straight rods forked at one end or both ends, slightly C-shaped rods, knobbed at tips form body wall .... *Chiridota rigida* (Semper)

ACTINOPYGA ECHINITES (Jaeger).

Mulleria echinites JAEGER (1833); SELENKA (1867); SEMPER (1868); LUDWIG (1882); LAMPERT (1885, 1896); THEEL (1886a); SLUITER (1894); WHITELEGGE (1897); PEARSON (1910b); ERWE (1913); MITSUKURI (1912).

Actinopyga echinites SAVILLE-KENT (1893); BEDFORD (1898); PEARSON (1914b); DOMANTAY (1933), (1953).

Holothuria (Actinopyga) echinites PANNING (1929).

Body ovate and subcylindrical. Mouth ventral with peltate tentacles; anus slightly dorsal with five calcareous teeth. Body wall thick and tough. Papillæ scattered distinctly over the dorsal side. Numerous pedicels on ventrum, arranged in three distinct series and few in interambulacra.

Calcareous deposits: Mostly of dichotomously branched rods and simple rosettes, complete dichotomously branched rosettes.

Locality: South side of Bataan, Manila Bay. Specimen taken from at a depth of 64.05 meters.

MERTENSIOTHURIA CURIOSA (Ludwig).

Holothuria fusco-cinera JAEGER (1838); SEMPER (1863); LUDWIG (1882, 1886a, 1887d); SLUITER (1887); LUDWIG & BARTHELS (1892); SAVILLE-KENT (1893); CLARK (1921, 1932); DOMANTAY (1933); MORTENSEN (1934).

Holothuria curiosa LUDWIG (1875); LAMPERT (1885); THELL (1886a); SLUITER (1901); PEARSON (1910a, 1913); DOMANTAY (1953).

Mertensiothuria curiosa (Ludwig); DEICHMANN (1958).

Body robust, mouth and anus terminal, both slightly ventral. Specimen measured 102 mm long, 57 mm in diameter, and 35 mm deep. Papillæ dark brown encircled with lighter ring at base. Pedicels on ventral side numerous, appearing to be in five single rows but not very distinct. Lateral and dorsal sides with irregular series of low tubercles.

Calcareous deposits from ventral body wall consisting of buttons with two long holes at center and four small ones at each end. Dorsal papillæ with plates, buttons, tables, and supporting rods. Tentacles with supporting rods. Disk of tables with 10 to 12 small perforations, others with four large inner holes alternating with four small ones. Tables numerous from dorsal body wall. Tables with four pillars and one cross beam terminating into a simple spiny crown. Irregular buttons varying in the number of perforations.

Color: Brown dorsally and lighter color to grayish yellow ventrally.

Locality: Sangley Point, Cavite, Manila Bay. Specimen taken from the muddy bottom at a depth of 18.3 meters.

MERTENSIOTHURIA BRAUNI (Helper).

Holothuria brauni HELFER (1912b).
Mertensiothuria brauni (Helper); DEICHMANN (1958).

Body cylindrical, mouth circular at anterior end with big opening surrounded by a thick area of body wall with 20 peltate tentacles. Anus terminal. Specimens with average measurement of 91 mm long and 38 mm in diameter. Papillæ scattered all over body wall, tips conical and warty; dorsal papillæ smaller than ventral ones. Right and left ambulacra with bigger papillæ modified into numerous pedicels. Skin rough to the touch.

Calcareous deposits surrounding mouth button-shaped with six perforations; buttons from body wall with 6 to 10 perforations; tables with 8 marginal holes around a big central one.

Color: In preserved state, dark brown dorsally and lighter ventrally.

Locality: Bataan side of Manila Bay. Collected from a sandy region among rocks at a depth of 31.11 meters.

BRANDTOTHURIA IMPATIENS (Forskal).

Fistularia impatiens FORSKAL (1775).
Holothuria aphanes LAMPERT (1885); OSTERGREN (1898); SLUITER (1901).
Holothuria fulva QUOY & GAIMARD (1833).
Holothuria botellus SELENKA (1867, 1868); SEMPER (1868); SAVILLE-KENT (1893).
Holothuria impatiens SELENKA (1867); SEMPER (1868, 1869); GRAY (1872); MARENZELLER (1874); LUDWIG (1879, 1880, 1882, 1883, 1887, 1887d, 1888, 1889–92); HAACKE (1880); BELL (1894,

1887b, 1887c, 1888), LAMPERT (1885, 1889, 1896); THEEL (1886); SLUITER (1887, 1895, 1901); HEROURD (1889, 1893); SAVILLE-KENT (1893); KOEHLER (1901, 1927); BORDAS (1889a, 1898, 1899); BEDFORD (1898, 1899); OSTERGREN (1898); RISSO (1899, 1900); CLARK (1902a, 1902b, 1920, 1921, 1923, 1925, 1926, 1932, 1946); KONINGSBERGER (1904); FISHER (1907); KOEHLER & VANEY (1908); PEARSON (1910a, 1910b, 1913, 1914); MITSUKURI (1912); ERWE (1913); MORTENSEN (1926); DEICHMANN (1926, 1930); SCHMIDT (1929, 1930); STEPHENSON ET AL (1931); DOMANTAY (1933, 1953a, 1953b); PANNING (1935).

Brandtothuria impatiens (Forskal); DEICHMANN (1958).

Body cylindrical, tapering toward the anus. Mouth and anus terminal. Mouth with 20 peltate tentacles. Papillæ on dorsum bigger with conical tips and warty bases. Integument rough to the touch.

Deposits from body wall consisting of large smooth buttons with three pairs of holes and a few with eight to ten holes. Numerous large tables with six to eight perforations at base and four pillars forming a spiny crown distally.

Color: Dark brown on dorsum, lighter ventrally.

Locality: Central area of Manila Bay. Specimen taken from sandy-muddy bottom at a depth of 25.62 meters.

FOSSOTHURIA SCABRA (Jaeger).

Holothuria scabra JAEGER (1833); SELENKA (1867, 1868); SEMPER (1868); LUDWIG (1880, 1881, 1882, 1883, 1887b, 1887d, 1887e, 1888, 1889–92, 1899); HAACKE (1880); LAMPERT (1885); THEEL (1886a); SLUITER (1887, 1895, 1901); LAMPERT (1896); KONINGSBERGER (1904); KOEHLER & VANEY (1908); PEARSON (1910a, 1910b, 1913); MITSUKURI (1912); CLARK (1920, 1921, 1923, 1932, 1946); SCHMIDT (1930); DOMANTAY (1933, 1953).
Holothuria tigris SELENKA (1867).
Holothuria cadelli BELL (1887).
Holothuria gallensis PEARSON (1903).
Fossothuria scabra (Jaeger); DEICHMANN (1958).

Body cylindrical and appears stout in a contracted form. Mouth ventral with 20 peltate tentacles; anus terminal. Cuvierian organs wanting. Minute papillæ irregularly scattered over body with dark grayish tips encircled with lighter area.

Calcareous deposits mostly buttons and tables with spiny projections at top and one large central hole surrounded by smaller marginal ones at base. Some buttons with markedly indented edges. Supporting rods expanded at middle with perforations and silghtly spiny at both ends.

Color: Grayish on dorsum and whitish gray on ventrum with a shade of yellowish color and often white. It grows to a large size measuring 400 mm long and about 100 mm in diameter.

Locality: San Nicholas shoal, Manila Bay. Collected from the sandy-muddy bottom at a depth of 36.6 meters.

LESSONOTHURIA PARDALIS (Selenka).

Holothuria pardalis SELENKA (1867); LUDWIG (1880, 1880a, 1883, 1887, 1888); BELL (1884); LAMPERT (1885, 1889, 1895); THEEL (1886); SLUITER (1887, 1901); HEROUARD (1893); KOEHLER (1895); WHITEGGE (1917); BEDFORD (1896); VOELTZKOW (1902); FISHER (1907); KOEHLER & VANELY (1908); PEARSON (1913–14); ERWE (1919); CLARK (1920, 1925, 1932, 1946); SCHMIDTH (1930); STEPHENSON ET AL (1931); HOLLY (1932); DOMANTAY (1933); MORTENSEN (1934); PANNING (1935).

Holothuria lineata LUDWIG (1875, 1880, 1882); BELL (1884); LAMPERT (1885); THEEL (1886); PEARSON (1910, 1913).

Holothuria pardalis var. *insignis* SLUITER (1890); BEDFORD (1899).

Lessonothuria pardalis (Selenka); DEICHMANN (1958).

Body cylindrical and tapering towards both ends. Mouth and anus terminal. Mouth with light yellow peltate tentacles. Pedicels minute, scattered all over body.

Pedicels on ventrum fewer than on dorsum. Dorsum sharply marked off from ventrum. Body wall smooth to the touch.

Calcareous deposits consisting of numerous irregular button with 3 to 4 pairs of holes; tables with spiny disk.

Color: Dorsum brownish or straw color with several black spots usually in two rows, twelve or more spots in each row. Ventrum lighter without blotches or spots. Color pattern variable.

Locality: Bataan side, Manila Bay. Specimen taken from a sandy region with coral fragments at a depth of 31.11 meters.

LUDWIGOTHURIA ATRA (Jaeger).

Holothuria radackensis CHAMISSO & EYSENHARDT (1821).

Holothuria amboinensis SEMPER (1866).

Holothuria atra Jaeger var. *amboinensis* THEEL (1886a); BEDFORD (1898).

Holothuria sanguinolenta BELL (1893); DOMANTAY (1933).

Holothuria atra JAEGER (1833); SELENKA (1867); SEMPER (1868, 1869); LUDWIG (1881, 1882, 1883, 1887b, 1887d, 1887e); BELL (1884, 1886, 1887a, 1887c, 1888); LAMPERT (1885, 1896); THEEL (1886a); SLUITER (1887, 1889–92); SAVILLE-KENT (1893); STUDER (1893);

KOEHLER (1895a); WHITELEGGE (1897, 1903); HEDLEY (1899); CLARK (1901a, 1901b, 1920, 1921, 1923, 1925, 1932); VOLTZKOW (1902; KONINGSBERGER (1904); GARDINER (1904); EDWARDS (1907); KOEHLER & VANEY (1908, 1910); PEARSON (1910a, 1913); MITSUKURI (1912); ERWE (1913) BROOKE (1927); PANNING (1928a, 1935) STEPHENSON (1913); BAKER (1928b, 1929a); ENGEL (1933); DOMANTAY (1953a, 1953b, 1954).

Ludwigothuria atra (Jaeger); DEICHMANN (1958).

Body cylindrical, slightly tapering and blunt at both ends. Mouth and anus terminal. With 20 peltate tentacles. In preserved specimen body wall smooth, thick and tough. Papillæ similar to tube feet all over body, crowded ventrally, appearing as white spots at a distance.

Calcareous deposits consisting of tables with perforated disk, with four pillars connected by two crossbeams. Few rosettes intermixed with tables.

Color: Blackish or purplish black.

Locality: Bataan side, Manila Bay. Specimen taken from sandy region among rocks at a depth of 31.11 meters.

Family MOLPADIIDÆ J. Muller

Genus PARACAUDINA Heding

Key to the species of Paracaudina

A. Plates with edge spiny; shapes irregular with two to eight perforations, of unequal size .... *australis*

B. Spicules with calcareous deposits lacking .... *aspiculata* sp. nov.

PARACAUDINA AUSTRALIS (Semper).

Caudina australis SEMPER (1868).
Molpadia autralis SEMPER (1868).
Pseudocaudina australis HEDING (1931a).
Paracaudina australis HEDING

Body long, cylindrical, anterior region stout, posterior region tapering and bearing anus at its end. Mouth slightly oval, anterior end forming a flat circular disk provided with 15 simple digitate tentacles measuring 3 mm long and 2 mm wide. Tentacles short, plump projections. Body wall smooth and soft to the touch. Preserved specimen measuring 172 mm long and 52 mm in diameter at its middle part.

Calcareous deposits resemble irregular biscuit-shaped, with two to eight perforations, with somewhat spiny margins. Spicules from different parts of body forming rosettes, varying in shape and size.

Color: Preserved specimen dark brownish pink.

Locality: Specimen taken from mud and soft sandy bottom at a depth of 21.91 meters. Coast of Cavite, Manila Bay.

PARACAUDINA ASPICULATA sp. nov.

Body cylindrical, short and plump. Body wall smooth, somewhat transparent and slimy. Mouth and anus terminal. Posterior part more or less elongated in the caudal region. Anus encircled by dark concentric lines, more or less four to five in number. Mouth cavity round, surrounded by 14 to 15 short, digitate tentacles that protrude slightly.

Measurement of specimens collected, range from 43 to 52 mm long and 21 to 59 mm in diameter.

No calcareous deposits of any kind. It cannot be due to the dissolution by the formalin solution used in the preservation because all other specimens collected and preserved at the same time in the same manner show spicules of calcareous deposits intact. Newly collected specimens of this species did not show any calcareous deposit, or devoid of spicules. The new species is named *aspiculata*, meaning without any spicules.

Color: Transparent white in life, and opague in preserved state.

Specimens examined: 4, Cavite coast of Manila Bay. Bathymetrical range, 21.91 meters. Bottom, sandy mud.

Type Specimen: 53 mm long and 29 mm in diameter; deposited in the Biology Research Laboratory of the Graduate School, University of Sto. Tomas, Manila.

CHIRIDOTA RIGIDA Semper.

Chiridota rigida SEMPER (1868); LUDWIG (1892); CLARK (1907); DOMANTAY (1933).
Chiridota liberata SLUITER (1888); LUDWIG (1892).
Chiridota amboinensis LUDWIG (1888, 1892).
Chiridota hawaiiensis FISHER (1907).

Body cylindrical, tapering towards posterior end. With 12 palmate tentacles, the two terminals, large and long. Majority of tentacles asymmetrically arranged with six digits on one side and sometimes seven on the other side, thus forming 12 to 13 digits in all. Adult specimens measuring between 30 to 65 mm long. Wheel-papillæ arranged in series of five along the interambulacral areas. Wheel-papillæ white.

Calcareous deposits consisting of numerous wheels with six spokes, straight rods forked at one or both ends, slightly C-shaped rods, knobbed at tips from body wall; wheels grouped into 10 to 80, located posteriorly and anteriorly of body wall, more crowded anteriorly; curved rods fewer in posterior region. Numerous oval grains also present.

Color: Varying from red, reddish purple to dark violet. Skin transluscent.

Locality: Bulacan side, Manila Bay. Taken from the sandy-muddy bottom under rock fragments at a depth of 12.81 meters.

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SUPPLEMENTARY HOST LIST AND CHECKLIST OF PHILIPPINE PLANT PESTS

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This work consists of two parts, namely: (*1*) a supplement to the latest list of Philippine pests that was published by Capco in 1959, and (*2*) a checklist of insects and other pests attacking cultivated plants in the Philippines, excluding ornamentals. In the first list the pests were listed under the host plant. In the second list the species were grouped into the various classes, orders, families, and subfamilies.

To date there are 670 insect pests, 34 mites, and 23 pests other than insects which are identified with their hosts.

The latest list of Philippine pests was compiled and published by Capco in 1959. In it are enumerated 522 known pests from 19 field crops, 32 fruit trees, and 32 vegetables. This list serves as a handy reference, not only for fieldmen who have had previous entomology training and are familiar with common pests, but also for those who wish to check whether a Philippine pest has been reported at all. The references omitted by Capco are reviewed and incorporated here; sources of information from unpublished reports are included but enclosed in parenthesis. Users of Capco's list must refer to the checklist presented here for synonnymy of species, changes in generic and family names, and corrections of misspelled scientific names.

I. A SUPPLEMENT TO CAPCO'S LIST OF PLANT PESTS

The supplement adds many insect pests (some having been introduced from abroad) and mites that have been reported or observed in this country. Pests of wheat, sorghum, kenaf, grapes, ginger, rubber, and lumbang are also included because these crops are now being grown in a commercial scale in certain areas in the Philippines. More specifically, the supplement includes 29 species of mites and 153 insect pests which are reported for the first time. New host records have been observed for many insect pests. However, the supplement is by no means complete. There are many more pests found on various crops but the delay in the identification of specimens prevent immediate report on them.

Identification of specimens regarded as new records was done by me or by specialists from abroad, mostly from the U. S. National Museum (USNM) and U. S. Department of Agriculture (USDA), Washington, D. C., and from the British Museum of Natural History (BMNH), London. To them I express sincere thanks. I wish to thank also the fieldmen of the Bureau of Plant Industry who sent specimens observed on various crops. The pests reported here as new records are deposited in the insect collection of the Bureau of Plant Industry, Manila.

The arrangement of pests followed here is the same as that in Capco's list where the field crop pests were treated first, the pests of fruit trees next, and of vegetables last. References to pages in Capco's list are indicated after the scientific name of the crop. Pests considered rather common or serious are marked with an asterisk. Doubtful records have a question mark before the name of the insect.

RICE (ORYZA SATIVA Linn.) see Capco, p. 7

	Reference
Insects attacking the roots	
HEMIPTERA	
Burrower bugs:	
Geotomus pygmaeus (Dallas), Cydnidæ (Identified in 1954 by Mr. R. Sailer, USDA)	New record
Macroscytes transversus Burm., Cydnidæ	Walker, 1962
HOMOPTERA	
Root louse:	
Tetraneura oryzae V. d. Goot, Aphididæ	Walker, 1962
COLEOPTERA	
White grub:	
Anomala sulcatula Burmeister, Scarabaeidæ	Cendaña & Calora, 1967
Insects attacking the stem	
DIPTERA	
Rice seedling flies:	
Atherigona orientalis Schin., Anthomyiidæ	Walker, 1962
Atherigona seticauda Mall., Anthomyiidæ	Johnston, 1962a
Mepachymerus crucifer (Meig.), Chloropidæ (Identified in 1954 by Mr. C. Sabrosky, USDA)	New record
Mepachymerus ensifer (Thomas), Chloropidæ (Identified in 1954 by Mr. C. Sabrosky, USDA)	New record
Hydrellia philippina Ferino, Ephydridæ	Ferino, 1968
LEPIDOPTERA	
Stemborers:	
Chilotraea infuscatella (Sn.), Crambidæ	Walker, 1962
Chilotraea polychrysa (Meyr.), Crambidæ	Johnston, 1962a
(*Pyrausta nubilalis* Hubn.), Pyraustidæ =*Ostrinia damoalis* (Walker)	Walker, 1962
COLEOPTERA	
Tenebrionid beetle:	
[*Opatrum depressum* (F.)], Tenebrionidæ =*Gonocephalum depressum* (F.)	Walker, 1962
Insects attacking the leaves	
ORTHOPTERA	
Short-horned grasshoppers:	
(*Locusta danica* Linn.), Acrididæ =*Locusta migratoria manilensis* (Meyne)	Walker, 1962
[*Locusta cinerascens* (F.)], Acrididæ =*Locusta migratoria manilensis* (Meyne)	Johnston, 1962a

Oxya intricata Stal, Acrididæ	Johnston, 1962a
Patanga succincta (Linn.), Acrididæ	Johnston, 1962a
Valanga nigricornis (Burm.), Acrididæ	Johnston, 1962a

HOMOPTERA

Green rice leafhopper:

Nephotettix cincticeps (Uhler), Cicadellidæ	Ishihara, 1965b
Nephotettix impicticeps Ishihara, Cicadellidæ (=*N. bipunctatus* F.)	Ishihara, 1965a & b

Other leafhoppers:

Cidadulina bipunctella Mats., Cicadellidæ	Ishihara, 1965b
Inazuma dorsalis (Motsch.), Cicadellidæ	Walker. 1962; Ishihara, 1965b
Laodelphax striatella (Fallen), Delphacidæ	Metcalf, 1943
**Sogatella furcifera* (Horvath), Delphacidæ	Metcalf, 1943
(*Zygina subrufa* (Motsch.), Cicadellidæ =*Thaia subrufa* (Motsch.)	Walker, 1962

Green scale:

?*Coccus viridis* Green, Coccidæ	Walker, 1962

LEPIDOPTERA

Rice armyworm:

Spodoptera exempta Walk., Noctuidæ	Walker. 1962
(*Cirphis unipuncta* Haworth), Noctuidæ =*Pseudaletia separata* (Walk.)	Johnston, 1962a

Cutworm:

(*Plusia chalcites* Esper), Noctuidæ =*Chrysodeixis chalcites* (Esper)	Walker, 1962

Foliage-feeding caterpillars:

?*Bradina admixtalis* Walk.	Walker, 1962
Laelia subrosea Walk., Lymantriidæ	Walker, 1962
(=*Laelia subrufa* Sn.), Lymantriidæ	Johnston, 1962a
Marasmia venilialis (Walk.), Pyraustidæ	Johnston, 1962a
Naranga aenscens Moore, Noctuidæ	Walker, 1962
Parasa lepida (Cram.), Limacodidæ	Walker, 1962

Rice leafrollers:

(*Hesperia philino* Mosch.), Hesperiidæ =*Parnara mangala* Moore	Uichanco & Sacay, 1949
Parnara philippina H.-S., Hesperiidæ	Seitz, 1927

Nymphalid green caterpillar:

Melanitis leda determinata Butler, Satyridæ	Walker, 1962

COLEOPTERA

Halticid beetle:

Altica sp., Chrysomelidæ (Identified in 1965 by Dr. R. White, USDA) — New record

Black hispid beetle:

Hispellinus callicanthus (Bates), Chrysomelidæ — Johnston, 1962a

Broad-nosed weevil:

Hypomeces squamosus (F.), Curculionidæ — Walker, 1962

Scarabaeid beetle:

(*Heteronychus interruptus*), Scarabaeidæ =*Serica interrupta* Walk. — Walker, 1962

DIPTERA

Rice leafminer:

Napomyza sp., Agromyzidæ (Identified in 1953 by Mr. C. Sabrosky, USDA) — New record

ACARINA

Mites:

Abacarus oryzae Keifer, Eriophyidæ — Keifer, 1963

Tetranychus truncatus Ehara, Tetranychidæ — Rimando, 1962b

Insects attacking panicles

HOMOPTERA

Rusty plum aphid:

Hysteroneura setariae (Thomas), Aphididæ — Baltazar, 1962a

HEMIPTERA

Coreid bug:

Cletus trigonus (Thunb.), Coreidæ — Johnston, 1962a

Insects attacking stored rice

COLEOPTERA

Lesser meal worm:

Alphitobius diaperinus (Panzer), Tenebrionidæ — Johnston, 1962a

Black fungus beetle:

Alphitobius laevigatus (F.), Tenebrionidæ — Walker, 1962

Slender-horned flour beetle:

Gnathocerus maxillosus (F.), Tenebrionidæ — New record

Small-eyed flour beetle:

Palorus ratzeburgii Wissmann, Tenebrionidæ — (Abalos, 1966)

Siamese grain beetle:

Lophocateres pusillus Klug, Ostomidæ — (Abalos, 1966)

Cadelle:

Tenebroides mauritanicus (Linn.), Ostomidæ — New record

Flat grain beetle:

Cryptolestes pusillus (Schonherr), Cucujidæ (=*Laemophloeus pusillus*) — New record

Saw-toothed grain beetle:

Orzaephilus surinamensis Linn., Cucujidæ — (Abalos, 1966)

Foreign grain beetle:

Ahasversus advena Walth, Cucujidæ — Labadan & Viado, 1959

Khapra beetle:

Trogoderma granarium Everts, Dermestidæ — New record

LEPIDOPTERA

Green rice moth:

Doloessa viridis Zeller, Pyraustidæ — New record
(Identified in 1967 by Mr. Shaffer, BMNH)

SUGARCANE (SACCHARUM OFFICINARUM Linn.), *see* **Capco, p. 11**

Insects attacking the underground parts

ISOPTERA

Termites:

Coptotermes vastator Light, Rhinotermitidæ — Johnston, 1961b
Microcerotermes losbañosensis (Oshima), Termitidæ — Johnston, 1961b

HEMIPTERA

Burrower bugs:

Macroscytes transversus Burm., Cydnidæ — Johnston, 1961b
Stibaropus callidus Schiödte, Cydnidæ — Johnston, 1961b
Stibaropus molginus Schiödte, Cydnidæ — Johnston, 1961b

Insects attacking the stalk

COLEOPTERA

Pinhole beetle:

Xyleborus affinis Eichh., Scolytidæ — Johnston, 1961b

LEPIDOPTERA

Sugarcane borers:

(*Pyrausta nubilalis* Hubn.), Pyraustidæ =*Ostrinia damoalis* Walker — Johnston, 1961b
?(*Schoenobius bipunctifer*), Schoenobiidæ =*Tryporyza incertulas* (Walk.) — Johnston, 1961b
Xestocasis iostrota (Meyrick), Heliodinidæ — Diakonoff, 1967

Pests attacking the leaves

ACARINA

Mites:

Oligonychus orthius Rimando, Tetranychidæ	Rimando, 1962
Tetranychus truncatus Ehara, Tetranychidæ	Rimando, 1962
Tetranychus kanzawai Kishida, Tetranychidæ	Rimando, 1962

HOMOPTERA

Rice bug:

Leptocorixa acuta Thunb., Coreidæ	Johnston, 1961b

HOMOPTERA

Aphid:	
[*Macrosiphum avenæ* (F.)], Aphididæ	Johnston, 1961b
= *Macrosiphum* (*Sitobion*) *graminis* (Tak.)	
Mealybug:	
Icerya seychellarum (Westw.), Margarodidæ	Johnston, 1961b
Coccid:	
(*Antonina indica* Green), Pseudococidæ	
= *Antonina graminis* (Mask.)	Johnston, 1961b
Leafhoppers:	
Nephotettix apicalis (Motsch.), Cicadellidæ	Johnston, 1961b
Nirvana pallida Melichar, Cicadellidæ	Johnston, 1961b
Tettigella spectra (Dist.), Cicadellidæ	Uichanco, 1928
Paranda globiceps Melichar, Delphacidæ (Identified in 1959 by Mr. S. Capco, BPI, Manila)	New Record
Perkinsiella manilæ Muir, Delphacidæ	Johnston, 1961b
Perkinsiella pseudosinensis Muir	Muir, 1916
Perkinsiella saccharicida Kirkaldy, Delphacidæ	Metcalf, 1943
Perkinsiella saccharivora Muir, Delphacidæ	Uichanco, 1928
Stenocranus agamopsyche Kirk., Delphacidæ	Johnston, 1961b
Tropidocephala saccharivorella Mats., Delphacidæ	Muir, 1916
[*Ricania proxima* (Melichar)] Ricaniidæ	Uichanco, 1928
= *Ricania fumosa* (Walker)	
(*Dictyomorpha hectica* Haupt),[1] Dictyopharidæ	Uichanco, 1928

LEPIDOPTERA

Leaf-feeding caterpillars:

(*Cirphis unipuncta* Haworth), Noctuidæ	Uichanco, 1928
= *Pseudaletia separata* (Walk.)	
Siboga falsella Sn., Pyraustidæ	Johnston, 1961b
Utetheisa lotrix (Cram.), Arctiidæ	Johnston, 1961b
(*Euproctis virguncula* Walk.), Lymantriidæ	Johnston, 1961b
= *Porthesia virguncula* (Walk.)	
(*Lælia subrufa* Sn.), Lymantriidæ	Johnston, 1961b
= *Lælia subrosea* (Walk.)	

[1] The name is not valid since it was not described by Haupt, *see* Metcalf, 1942: Uichanco (1928) was the original user of this name.

Leafminer:	
(*Cosmopteryx pallifasciella* Sn.), Cosmopterygidæ = *Cosmopteryx dulcivora* Meyrick	Johnston, 1961b
Leafroller:	
Marasmia trapezealis (Guen.), Pyraustidæ	Johnston, 1961b

CORN (ZEA MAYS Linn.), see Capco, p. 15.

Insect attacking the leaves

HOMOPTERA

Leafhopper:	
Cicadulina bipunctella Mats., Cicadellidæ	Ishihara, 1965b

Insects attacking stored corn

COLEOPTERA

Siamese graint beetle:	
Lophocateres pusillus Klug, Ostomidæ	Schultze, 1915
Cigarette beetle:	
Lasioderma serricorne (F.), Anobiidæ	Viado & Labadan, 1959
Small-eyed flour beetle:	
Palorus ratzeburgii Wissmann, Tenebrionidæ	New record
Slender-horned flour beetle:	
Gnathocerus maxillosus (F.), Tenebrionidæ (Identified in 1965 by Mr. T. J. Spilman, USDA)	New record
Mexican grain beetle:	
Pharaxonotha kirschi Reitt., Cryptophagidæ	New record
Foreign grain beetle:	
Ahasversus advena Walth, Cucujidæ	Labadan & Viado, 1959

WHEAT (TRITICUM VULGARE Vill.)

Insects attacking the stem

HOMOPTERA

Green bug:	
[*Toxoptera graminum* (Rondani)], Aphididæ = *Schizaphis graminum* (Rondani)	Baltazar, 1962a

LEPIDOPTERA

Purplish rice stemborer:	
Sesamia inferens (Walk.), Noctuidæ	Baltazar, 1962a

Insects attacking the leaves

ORTHOPTERA

Citrus locust:	
Melicodes tenebrosa (Walk.), Acrididæ	(Pangga, 1963)

Short-horned grasshoppers:

Aiolopus tamulus (F.), Acrididæ (Pangga, 1963)
Oxya velox (F.), Acrididæ (Pangga, 1963)
Atractomorpha psittacina (Haan), Acrididæ (Pangga, 1963)

Long-horned grasshoppers:

Phaneroptera furcifera Stal, Tettigoniidæ (Pangga, 1963)

HOMOPTERA

White rice leafhopper:

Tettigella spectra (Dist.), Cicadellidæ (Pangga, 1963)

Corn leaf aphid:

Rhopalosiphum maidis (Fitch), Aphididæ (Pangga, 1963)

LEPIDOPTERA

Cutworms:

Prodenia litura (F.), Noctuidæ Guttierez, 1958
(*Plusia chalcites* Esper), Noctuidæ (Pangga, 1963)
= *Chrysodeixis chalcites* (Esper)

Rice armyworm:

Spodoptera mauritia (Boisd.), Noctuidæ Guttierez, 1958

Corn earworm:

Heliothis (*Helicoverpa*) *armigera* (Hubn.), Noctuidæ New record

Bagworm:

(*Cryptothelea* sp.), Psychidæ (Pangga, 1963)
= *Eumeta* sp.

Insects attacking the panicles

HEMIPTERA

Rice bug:

Leptocorixa acuta Thunb., Coreidæ Gutierrez, 1958

Green stink bug:

Nezara viridula (Linn.), Pentatomidæ New record

HOMOPTERA

Rusty plum aphid:

Hysteroneura setariæ (Thomas), Aphididæ Baltazar, 1962a

Oat bird-cherry aphid:

Rhopalosiphum padi (Linn.), Aphididæ Baltazar, 1962a

English grain aphid:

Macrosiphum (*Sitobion*) *graminis* (Tak.), Aphididæ New record
(Identified in 1964 by Dr. J. Eastop, BMNH)

Other aphid:

Macrosiphum (*Sitobion*) sp., nr. *smilacifolium*, Aphididæ New record
(Identified in 1964 by Dr. J. Eastop, BMNH)

Green bug:
[*Toxoptera graminum* (Rondani)], Aphididæ — Baltazar, 1962a
= *Schizaphis graminum* (Rondani)

Pests other than insects

Mayas:
Munia jagori Martens, Ploceidæ — Guttierez, 1958
Munia orizivora Linn., Ploceidæ — Guttierez, 1958
Oroloncha everitti Tweed, Ploceidæ — Guttierez, 1958

Insects on stored wheat

COLEOPTERA

Rice weevil:
Sitophilus oryzæ (Linn.), Curculionidæ — New record

Lesser meal worm:
Alphitobius diaperinus (Panz.), Tenebrionidæ — New record
(Identified in 1965 by Mr. T. J. Spilman, USDA)

Dermestid beetle:
Trogoderma anthrenoides (Sharp), Dermestidæ — New record
(Identified in 1965 by Dr. J. Kingsolver, USDA)

LEPIDOPTERA

Angoumois grain moth:
Sitotroga cerealella (Oliv.), Gelechiidæ — New record

Rice moth:
Corcyra cephalonica (Stainton), Pyralidæ — New record

COCONUT (COCOS NUCIFERA Linn), see Capco, p. 19

Insects attacking stem and cabbage

COLEOPTERA

Coconut weevil:
(*Rhynchophorus schach* Oliv.), Curculionidæ — Johnston, 1961a
= *Rhynchophorus ferrugineus* (Oliv.)

Rhinoceros beetle:
Oryctes gnu Mohn., Scarabæidæ — New record
(= *Oryctes trituberculatus* Lansb.)

Engraver beetle:
Xyleborus perforans (Woll.), Scolytidæ — Schultze, 1915

Shot-hole beetles:
Crossotarsus lecontei Chap., Platypodidæ — New record
(Identified in 1965 by Dr. D. M. Anderson, USDA)
Crossotarsus sp., Platypodidæ — Pangga, 1960
Platypus jansoni Chap., Platypodidæ — Pangga, 1960

Insects attacking the leaves

COLEOPTERA

Hispine beetles:	
Brontispa angulosa Uhmann, Chrysomelidæ	Johnston, 1965
Brontispa banguiensis Uhmann, Chrysomelidæ	Johnston, 1965
Brontispa depressa Baly, Chrysomelidæ	Johnston, 1965
Brontispa longissima Gestro, Chrysomelidæ	Johnston, 1965
Brontispa surigaoana Uhmann, Chrysomelidæ	Johnston, 1965

ORTHOPTERA

Long-horned grasshopper:	
Sexava sp., Tettigoniidæ	New record

HOMOPTERA

Scale:	
Aonidiella aurantii (Mask.), Diaspididæ	Johnston, 1961a
Rusty plum aphid:	
Hysteroneura setariæ (Thomas), Aphididæ	Calilung, 1967
Other aphid:	
Astegopteryx nipæ (V. d. Goot), Aphididæ	Calilung, 1967
Leafhoppers: (Identified in 1954 by Dr. D. A. Young, USDA)	
Cicadella bipunctifrons (Stal), Cicadellidæ	New record
Cofana makilingensis (Baker), Cicadellidæ	New record
Ipocerus sp., nr. *kirkaldyi* Baker, Cicadellidæ	New record
Krisna sp., nr. *olivascens* Baker, Cicadellidæ	New record
Typhlocyba nigrobilineata Melichar, Cicadellidæ	New record
Makilingia colorata Baker, Cicadellidæ	New record
Ugyops impictus (Stal), Delphacidæ	New record
Herpis flavescens Muir, Derbidæ	New record
Kamendaka (Kamendaka) tayabasensis Muir, Derbidæ	New record
Lamenia flavescens Melichar, Derbidæ	New record
Leptaleocera nigrofasciata Muir, Derbidæ	New record
Mysidioides sp., nr. *tagalica* Muir, Derbidæ	New record
Pamendanga sp., nr. *fuscipennis* (Muir), Derbidæ	New record
Phaciocephalus sp., prob. *badius* Muir, Derbidæ	New record
Proutista moesta (Westw.), Derbidæ	New record
Proutista sp., nr. *lumholtzi* (Kirk.), Derbidæ	New record
Zeugma valdezi Muir, Derbidæ	New record
Zoraida mcgregori Muir, Derbidæ	New record
Nisia alba Melichar, Meenoplidæ	New record
Mindura sp., nr. *subfasciata* Stal, Nogodinidæ	New record
**Virgilia luzonensis* Baker, Lophopidæ	New record
Farona funerula (Melichar), Ricaniidæ	New record
Kallitaxila cruenta (Melichar), Tropiduchidæ	New record
Kallitaxila granulata Stal, Tropiduchidæ	New record
Chanitus sp., nr. *gramineus* F., Dictyopharidæ	New record
Uxantis consputa (Stal), Flatidæ (Identified in 1965 by Dr. J. Kramer, USDA)	New record

ACARINA

Mites:

Acathrix trymatus Keifer, Eriophyidæ	Keifer, 1962a
Dialox stellatus Keifer, Eriophyidæ	Keifer, 1962b
Notostrix attenuata Keifer, Eriophyidæ	Keifer, 1963
Scolaceums spiniferus Keifer, Eriophyidæ	Keifer, 1962b
Oligonychus velascoi Rimando, Tetranychidæ	Rimando, 1962b
Pritchardina fijiensis (Hirst), Tetranychidæ	Rimando, 1962b
Tenuipalpus orilloi Rimando, Tenuipalpidæ	Rimando, 1962b

Insect attacking the stamens

COLEOPTERA

Melyrid beetle:

Prinocerus caeruleipennis Perty, Melyridæ	Johnston, 1965

Insects attacking copra

COLEOPTERA

Cadelle:	
Tenebroides mauritanicus (Linn.), Ostomidæ	New record
Rice weevil:	
Sitophilus oryzae (Linn.), Curculionidæ	New record

ABACA (MUSA TEffiTILES Nee), *see* **Capco, p. 21.**

Insect attacking the rootstock

COLEOPTERA

Lesser banana weevil:

Polytus mellerborgi (Boh.), Curculionidæ (Identified in 1964 by Mrs. R. E. Spilman, USDA)	New record

Pests attacking the leaves

COLEOPTERA

Chrysomelid beetle:

Dercetes sp., Chrysomelidæ (Identified in 1965 by Dr. R. White, USDA)	New record

HEMIPTERA

Coreid bugs:

Sinervus basalis Poppius, Miridæ (Identified in 1954 by Dr. R. Sailer, USDA)	New record
[*Monalonium* (sic!)], Miridæ =*Monalion* sp.	Bartolome, 1951

HOMOPTERA

Leafhoppers:

(Identified in 1954 by Dr. D. Young, USDA)

Ipocerus sp., nr. *kirkaldyi* Baker, Cicadellidæ	New record
Tartessus ferrugineus (Walker), Cicadellidæ	New record
Makilingia nigra Baker, Cicadellidæ	New record
Nisia alba Melichar, Meenoplidæ	New record

ACARINA

Mite:

Tetranychus piercei McGregor, Tetranychidæ — Rimando, 1962b

BANANA (MUSA SAPIENTUM Linn.), ***see*** **Capco, p. 21.**

Pests attacking the leaves

ACARINA

Mites:

Oligonychus velascoi Rimando, Tetranychidæ — Rimando, 1962b

Tetranychus neocaledonicus Andre, Tetranychidæ — Rimando, 1962b

TOBACCO (NICOTIANA TABACUM Linn.), ***see*** **Capco, p. 23.**

Insects attacking stored tobacco, cigars and cigarettes

COLEOPTERA

Drugstore beetle:

Stegobium paniceum (Linn.), Anobiidæ — Schultze, 1915

LEPIDOPTERA

Tobacco moth:

Ephestia elutella (Hubn.), Pyralidæ — New record

Tineid caterpillar:

Setomorpha rutella Zeller, Tineidæ — Diakonoff, 1967

COFFEE (COFFEA spp.), ***see*** **Capco, p. 24.**

Insects attacking the leaves

COLEOPTERA

Leaf-feeders:

Metapocyrtus sp., Curculionidæ — New record

Rhyparida sp., Chrysomelidæ — New record

(Identified in 1958 by Mr. D. Weismann, USDA)

Insect attacking the berries

COLEOPTERA

Coffee berry borer:

(*Stephanoderes hampei* Ferr.), Scolytidæ — Anonymous, 1964

=*Hypothenemus hampei* (Ferr.)

CACAO (THEOBROMA CACAO Linn.), ***see*** **Capco, p. 26.**

Insects attacking the trunk and branches

ISOPTERA

Termite:

Neotermes spp., Kalotermitidæ — Snyder & Francia, 1962

Engraver beetles:

Coccotrypes graniceps Eichh., Scolytidæ — Schultze, 1915

Hypocryphalus obscurus Hopk., Scolytidæ — Schultze, 1915

Scolytid beetles:

(Identified in 1965 by Dr. S. L. Wood, Brigham Young Univ., Provo, Utah)

Hypothenemus areccae (Hornung), Scolytidæ	New record
Hypothenemus birmanus (Eichh.), Scolytidæ	New record
Hypothenemus sp., prob. *brunneus* Hopk., Scolytidæ	New record
Xyleborus fornicatus Eichh., Scolytidæ	New record
Xyleborus similis Ferr., Scolytidæ	New record
Shot-hole beetle:	
Platypus jansoni Chap., Platypodidæ	Pangga, 1960

Insects attacking the leaves

HOMOPTERA

Florida red scale: [*Chrysomphalus aonidum* (Linn.)], Diaspididæ =*Chrysomphalus ficus* Ash.	(Baltazar & Capco, 1960); Deang, 1962

COLEOPTERA

Pachyrrhynchids:

Pachyrrhynchus moniliferus Germar, Curculionidæ Uichanco & Sacay, 1949

Insects attacking the pods

COLEOPTERA

Scarabaeid beetle:	
Parastasia canaliculata Westw., Scarabaeidæ	New record
Scolytid beetles: (Identified in 1965 by Dr. S. L. Wood, Brigham Young Univ., Provo, Utah)	
Hypothenemus cruditus Westw., Scolytidæ	New record
Xyleborus fornicatus Eichh., Scolytidæ	New record

Insects attacking the stored seeds

COLEOPTERA

Cigarette beetle:	
Lasioderma serricorne (F.), Anobiidæ	New record

SWEET POTATO OR CAMOTE (IPOMOEA BATATAS (Linn.) Poir), *see* Capco, p. 29.

Pest attacking the leaves

ACARINA

Mite:	
Tetranychus truncatus Ehara, Tetranychidæ	Rimando, 1962b

CASSAVA (MANIHOT UTILISSIMA Pohl.), *see* Capco, p. 30.

Pests attacking the leaves

HOMOPTERA

Florida red scale: [*Chrysomphalus aonidum* (Linn.)], Diaspididæ =*Chrysomphalus ficus* Ash.	(Capco & Baltazar, 1960)

Whitefly:

Bemisia tabaci (Genn.), Aleyrodidæ — New record

ACARINA

Mite:

Tetranychus kanzawai Kishida, Tetranychidæ — Rimando, 1962b

GABI (COLOCASIA ESCULENTUM (Linn.) Schott), *see* **Capco, p 30.**

Pests attacking the leaves

COLEOPTERA

Corn silk beetle:

Monolepta bifasciata (Hornst), Chrysomelidæ — New record

ACARINA

Mite:

Schizotetranychus lechrius Rimando, Tetranychidæ — Rimando, 1962a

IRISH POTATO (SOLANUM TUBEROSUM Linn.), *see* **Capco, p. 31.**

Insects attacking the leaves

COLEOPTERA

Chrysomelid beetles:

(Identified in 1965 by Dr. R. White, USDA)

Dercetes spp., Chrysomelidæ — New record

Altica sp., Chrysomelidæ — New record

Lady beetle:

Epilachna philippinensis remota Dieke, Coccinellidæ — New record

Pachyrrhynchids:

Metapocyrtus (*Metapocyrtus*) *derasus* Boh., Curculionidæ — New record

Metapocyrtus (*Metapocyrtus*) *dolosus* Heller, Curculionidæ — New record

LEPIDOPTERA

Corn earworm:

Heliothis (*Helicoverpa*) *armigera* Hubn., Noctuidæ — New record

YAM (DIOSCOREA spp.)

Insect attacking the leaves

COLEOPTERA

Corn silk beetle:

Monolepta bifasciata (Hornst), Chrysomelidæ — Johnston, 1963

COTTON (GOSSYPIUM spp.), *see* **Capco, p. 32.**

Insects attacking the stem

HOMOPTERA

Filamentous mealybug:

[*Pseudococcus filamentosus* (Ckll.)],Pseudococcidæ — Johnston, 1962b

=*Nipæcoccus filamentosus* (Ckll.)

COLEOPTERA

Broad-nosed weevil:	
Hypomeces squamosus (F.), Curculionidæ	New record

Insects attacking the leaves

HEMIPTERA

Squash bug:	
Leptoglossus membranaceus (F.), Coreidæ	New record
Lygæid bug:	
Graptostethus sp., Lygaeidæ	New record

HOMOPTERA

Leafhoppers:	
Nirvana philippinensis Baker, Cicadellidæ	New record
Kallitaxila granulata (Stal), Tropiduchidæ	New record
Filamentous mealybug:	
[*Pseudococcus filamentosus* (Ckll.)], Pseudococcidæ	Johnston, 1962b
=*Nipæcoccus filamentosus* (Ckll.)	

COLEOPTERA

Broad-nosed weevils:	
Hypomeces squamosus (F.), Curculionidæ	New record
Metapocyrtus (*Trachycyrtus*) sp., Curculionidæ	New record
Tanymecus sciurus (Oliv.), Curculionidæ	Johnston, 1962b
Corn silk beetle:	
Monolepta bifasciata (Hornst), Chrysomelidæ	New record
Leaf-feeding beetle:	
Amphimela meroorum Weise, Chrysomelidæ	New record

LEPIDOPTERA

Noctuid caterpillar:	
(*Acontia intersepta* Guen.), Noctuidæ	Johnston, 1962b
=*Xanthodes intersepta* Guen.	
Leafrollers:	
Homona menciana Walk., Tortricidæ	Johnston, 1962b
Homona phanaca Meyr., Torticidæ	Johnston, 1962b

Insects attacking the bolls

HEMIPTERA

Lygaeid bugs:	
Oxycarenus hyalinipennis (Costa), Lygaeidæ	Johnston, 1962b
Oxycarenus lugubris Motsch., Lygaeidæ	Johnston, 1962b

LEPIDOPTERA

Seed borer:	
Pyroderces simplex Walsingham, Cosmopterygidæ	Diakonoff, 1967

KENAF (HIBISCUS CANNABINUS Linn.).

Insects attacking the stem and shoots

HOMOPTERA

Tree hoppers:

Gargara luconica (Fairm.), Membracidæ	New record
Leptocentrus manilænsis Funkh., Membracidæ	New record
Tricentrus plicatus Funkh., Membracidæ	New record
Sipylus sp., Membracidæ	New record

Tube-dweller:

Machaerota ensifera Burm., Machaerotidæ	New record

Twig borer:

Niphonoclea albata (Newm.), Cerambycidæ	New record

Insects attacking the leaves

HEMIPTERA

Cotton stainer:

Dysdercus poecilus (H.-S.), Pyrrhocoridæ	Rojales, 1953

HOMOPTERA

Leafhopper:

Empoasca biguttula (Ishida), Cicadellidæ	New record

COLEOPTERA

Leaf-feeding beetles:

Amphimela meroorum Weise, Chrysomelidæ	New record
Monolepta bifasciata (Hornst), Chrysomelidæ	New record
Phyllotreta sp., Chrysomelidæ	New record
(Identified in 1955 by Mr. G. Vogt, USDA)	

Insects attacking the flowers

COLEOPTERA

Cotton boll weevil:

Amorphoidea lata Mots., Curculionidæ	New record

LEPIDOPTERA

Pink bollworm:

Pectinophora gossypiella (Saund.), Gelechiidæ	New record

SORGHUM (ANDROPOGON SORGHUM Linn.), *see* **Capco, p. 35.**

Insects attacking the leaves

HOMOPTERA

Sugarcane aphid:

Longiungis sacchari (Zehnt.), Aphididæ	Calilung, 1967

Other aphid:

[*Sitobion miscanthi* (Tak.)], Aphididæ	Calilung, 1967
= *Macrosiphum* (*Sitobion*) *miscanthi* (Tak.)	

PINEAPPLE (ANANAS COMOSUS Linn.), *see* **Capco, p. 36.**

Pest attacking the leaves

ACARINA

Mite:	
Dolichotetranychus floridanus (Banks), Tenuipalpidæ	Rimando, 1962b

RAMIE (BOEHMERIA NIVEA Linn.), *see* **Capco, p. 37.**

Insects attacking the leaves

LEPIDOPTERA

Corn earworm:	
Heliothis (*Helicoverpa*) *armigera* Hubn., Noctuidæ	New record
Tortricid leafroller:	
Homona sp., Tortricidæ	New record

COLEOPTERA

Chrysomelid beetle:	
Phytorus sp., Chrysomelidæ	New record
Corn silk beetle:	
Monolepta bifasciata (Hornst), Chrysomelidæ	New record
Pachyrrhynchid:	
Metapocyrtus sp., Curculionidæ	New record

BAMBOO (BAMBUSA spp.), *see* **Capco, p. 38.**

Pests attacking the leaves

HOMOPTERA

Aphids:	
Astegopteryx bambusae (Buckt.), Aphididæ	Calilung, 1967
[*Astegopteryx similis* (V. d. Goot)], Aphididæ	Calilung, 1967
=*Oregma similis* V. d. Goot	

ACARINA

Mites:	
Aponychus corpuzæ Rimando, Tetranychidæ	Rimando, 1968
Aponychus vannus Rimando, Tetranychidæ	Rimando, 1968
Schizotetranychus floresi Rimando, Tetranychidæ	Rimando, 1962a

COLEOPTERA

Hispid beetle:	
Callispa cumingi Baly, Chrysomelidæ	Schultze, 1915

RUBBER (HEVEA RASILIENSIS Muell. Arg.)

Insects attacking the trunk and branches

COLEOPTERA

Bark borer:	
Aeolesthes induta Newm., Cerambycidæ	New record
Shot-hole borers:	

Crossotarsus sp., Platypodidæ — Pangga, 1960
Platypus jansoni Chap., Platypodidæ — Pangga, 1960

Insects attacking the leaves

HOMOPTERA

Black scale:
Saissetia nigra (Nietner), Coccidæ — Uichanco, 1934

LEPIDOPTERA

Tussock moth:
Orgyia australis postica (Walk.), Lymantriidæ — Uichanco, 1934

LUMBANG (ALEURITES MOLUCCANA (Linn.) Willd.)

Insects attacking the leaves

COLEOPTERA

Pachyrrhynchids:
Metapocyrtus sp., Curculionidæ — New record
Metapocyrtus (*Metapocyrtus*) *unilineatus* Heller, Curculionidæ — New record

HEMIPTERA

Cotton stainer:
(*Dysdercus megalopygus* Breddin), Pyrrhocoridæ — Uichanco, 1934
= *Dysdercus cingulatus* (F.)

HOMOPTERA

Transparent scale:
(*Aspidiotus translucens* Ckll. & Rob.), Diaspididæ — Uichanco, 1934
= *Aspidiotus destructor* Signoret

LEPIDOPTERA

Tussock moth:
Dasychira mendosa (Hubn.), Lymantriidæ — Uichanco, 1934

GRAPES (VITIS spp.)

Insects attacking the leaves and young shoots

HOMOPTERA

Wax scale:
Ceroplastes sinensis del Guercio, Coccidæ — New record

Tree hopper:
Tricentrus convergens (Walk.), Membracidæ — New record

LEPIDOPTERA

Bagworm:
Eumeta fuscescens (Sn.), Psychidæ — New record

Sweet potato hornworm:
Agrius convolvuli (Linn.), Sphingidæ — New record

BLACK PEPPER (PIPER NIGRUM Linn.)

Insects attacking the leaves

THYSANOPTERA

Thrips:

Gynaikothrips chavicæ Zimmerman, Thripidæ — Uichanco, 1934

GUAYABANO (ANONA MURICATA Linn.), *see* **Capco, p. 39.**

Insects attacking the leaves

LEPIDOPTERA

Leaf folder:

Homona bakeri Diakonoff, Tortricidæ — Diakonoff, 1967

AVOCADO (PERSEA AMERICANA Linn.), *see* **Capco, p. 40.**

Insects attacking the roots

ISOPTERA

Mound-building termite:

Macrotermes gilvus Hagen, Termitidæ — New record

Insects attacking the stem

ISOPTERA

Termite:

Neotermes spp., Kalotermitidæ — Snyder & Francia, 1962

COLEOPTERA

Shot-hole bettle:

Platypus jansoni Chap., Platypodidæ — Pangga, 1960

Insects attacking the leaves

LEPIDOPTERA

Tiger moth caterpillar:

Diacrisia metarhoda (Walk.), Arctiidæ — New record

HEMIPTERA

Lace bug:

Stephanitis typicus (Dist.), Tingidæ — New record

BALIMBING. (AVERRHOA CARAMBOLA Linn.), *see* **Capco, p. 42.**

Pests attacking the young shoots and leaves

HOMOPTERA

Tree hopper:

Gargara luconica (Fairm.), Membracidæ — New record

ACARINA

Mite:

Panonychus citri (McGregor), Tetranychidæ — Rimando, 1962b

Insect attacking the fruits

Fruitfly:

DIPTERA

Dacus (*Paratridacus*) *expandens* (Walk.), Tephritidæ — New record

(Identified in 1964 by Dr. D. E. Hardy, Univ. Hawaii, Honolulu)

CAMIAS (AVERRHOA BILIMBI Linn.)

Insect attacking the stem

COLEOPTERA

Shot-hole beetle:

Platypus jansoni Chap., Platypodidæ — Pangga, 1960

BIGNAY (ANTIDESMA BUNIUS (Linn.) Apeng.) *see* Capco, p. 42.

Insect attacking the leaves

HOMOPTERA

Florida red scale:

Chrysomphalus ficus Ash., Diaspididæ — New record

BREADFRUIT OR RIMAS (ARTOCARPUS COMMUNIS Forst.), *see* Capco, p. 43.

Insect attacking the stem and twigs

COLEOPTERA

Bark borer:

(*Batocera albofasciata* de Geer), Cerambycidæ — Schultze, 1915
= *Batocera rubus* (Linn.)

DURIAN (DURIO ZEBETHINUS Murr.)

Insect attacking the stem and twigs

LEPIDOPTERA

Coffee carpenter moth:

Zeuzera coffeæ Nietner, Cossidæ — New record

Insect attacking the fruits

LEPIDOPTERA

Durian borer:

Unidentified Oecophoridæ — New record

Pyraustid moth:

Dichocrocis punctiferalis (Guen.), Pyraustidæ — New record
(Identified in 1962 by Mr. H. Capps, USDA)

KAMANSI (ARTOCARPUS CAMANSI Blanco), *see* Capco, p. 43.

MARANG (ARTOCARPUS ODORATISSIMA Blanco)

NANGKA (ARTOCARPUS INTEGRA (Thunb.) Merr.)

Insect attacking the stem

COLEOPTERA

Shot-hole beetle:

Platypus jansoni Chap., Platypodidæ — Pangga, 1960

CAIMITO (CHRYSOPHYLLUM CAINITO Linn.), *see* Capco, p. 44.

Insects attacking branches

HOMOPTERA

Chinese wax scale:

* *Ceroplastes sinensis* del Guercio, Coccidæ — Baltazar, 1962b

COLEOPTERA

Scolytid beetle:

Hypothenemus birmanus (Eichh.,) Scolytidæ — New record

Insects attacking the leaves

HOMOPTERA

Florida red scale:

[*Chrysomphalus aonidum* (Linn.)], Diaspididæ = *Chrysomphalus ficus* Ash. — (Capco & Baltazar, 1960); Deang, 1962

Chinese wax scale:

* *Ceroplastes sinensis* del Guercio, Coccidæ — Baltazar, 1962b

CHICO OR SAPODILLA (ACHRAS SAPOTA Linn.), *see* Capco, p. 46.

Insects attacking the stem or trunk and branches

COLEOPTERA

Shot-hole borers:

Xylopsocus capuncinus (F.), Bostrichidæ — Celino *et al*, 1962

Xyleborus sp., Scolytidæ — Celino *et al*, 1962

(Identified in 1964 by Dr. S. L. Wood, Brigham Young Univ., Provo, Utah):

Hypothenemus areccæ (Hornung), Scolytidæ — New record

* *Hypothenemus birmanus* (Eichh.), Scolytidæ — New record

* *Scolytomimus pusillus* Eggers, Scolytidæ — New record

Nitidulid beetle:

[1] (*Carpophilus mutilatus* Er.), Nitidulidæ — Celino *et al*, 1962

Insects attacking the leaves

HOMOPTERA

Black citrus aphid:

Toxoptera aurantii (Fonsc.), Aphididæ — New record

Chinese wax scale:

Ceroplastes sinensis del Guercio, Coccidæ — Baltazar, 1962b

Star wax scale:

Vinsonia stellifera (Westw.), Coccidæ — New record

Insect attacking the fruit

DIPTERA

Fruitfly:

Dacus dorsalis Hendel, Tephritidæ — New record

CITRUS (CITRUS spp.), *see* Capco, p. 47.

Insects attacking the stem or trunk and branches

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[1] Found under chico bark but not considered a pest.

COLEOPTERA

Bark borer:

Belionota sp., prob. *sagittaria* Esch., Buprestidæ (Identified in 1966 by Mr. G. Vogt, USDA)	New record

Twig borer:

Oberea sp., Cerambycidæ	Macabasco, 1964

Shot-hole beetle:

Platypus jansoni Chap., Platypodidæ	Pangga, 1960

LEPIDOPTERA

Oecophorid:

Psorosticha neglecta Diakonoff, Oecophoridæ	Diakonoff, 1967

Pests attacking the young shoots and leaves

ACARINA

Mites:

Eotetranychus cendañai Rimando, Tetranychidæ	Rimando, 1962a
Schizotetranychus baltazaræ Rimando, Tetranychidæ	Rimando, 1962a
Pritchardina fijiensis (Hirst), Tetranychidæ	Rimando, 1962b
Brevipalpus californicus (Banks), Tenuipalpidæ	Rimando, 1962b
Brevipalpus obovatus Donnadieu, Tenuipalpidæ	Rimando, 1962b
Brevipalpus phoenicis (Geijskeo), Tenuipalpidæ	Rimando, 1962b
Tenuipalpis orilloi Rimando, Tenuipalpidæ	Rimando, 1962b

HOMOPTERA

Mango leafhopper:

Idioscopus clypealis (Leth.), Cicadellidæ	New record

Flatid:

Nephesa rosæ (Spinola), Flatidæ (Identified in 1965 by Dr. J. Kramer, USDA)	New record

Ricaniid:

Euricania sp., Ricaniidæ	New record

Scale:

Pinnaspis strachani (Cooley), Diaspididæ	Macabasco, 1963 & 1964

Whitefly:

Dialeurodes citri (Ash.), Aleyrodidæ	Macabasco, 1963

COLEOPTERA

Pachyrrhynchids:

Metapocyrtus (*Artapocyrtus*) *derasobaltinus* Heller, Curculionidæ	New record
Metapocyrtus (*Dolichocephalocyrtus*) *ruficollis* Waterhouse, Curculionidæ	New record
Metapocyrtus (*Metapocyrtus*) *impius* Erich., Curculionidæ	New record
Metapocyrtus (*Metapocyrtus*) *spinipes* Chev., Curculionidæ	New record

Metapocyrtus (*Orthocyrtus*) sp., Curculionidæ	New record
Metapocyrtus (*Trachycyrtus*) *adspersus* Waterh., Curculionidæ	New record
Metapocyrtus (*Trachycyrtus*) *profanus* Erich., Curculionidæ	New record
Pachyrrhynchus reticulatus Waterh., Curculionidæ	New record

LEPIDOPTERA

Tussock moth:

Lymantria lunata (Cram.), Lymantriidæ	Novero, 1958

Insects attacking the flowers and fruits

LEPIDOPTERA

Citrus rind borer:

Prays endolemma Diakonoff, Yponomeutidæ	Diakonoff, 1967

DIPTERA

Fruitflies:

Drosophila ananassæ (Doles.), Drosophilidæ (Identified in 1965 by Dr. D. E. Hardy, Univ. of Hawaii, Honolulu)	New record
Zaprionus multistriata Sturt., Drosophilidæ	Macabasco, 1963
Monacrostichus citricola Bezzi, Tephritidæ	Bezzi, 1913
Lonchæa citricola Bezzi, Lonchæidæ	Bezzi, 1913

DUHAT (SYZYGIUM CUMINI (Linn.) Skeels), *see* Capco, p. 50.

Insect attacking the leaves

LEPIDOPTERA

Tussock moth:

Lymantria lunata (Cram.), Lymantriidæ	Novero, 1958

MACOPA (SYZYGIUM JAVANICA (Linn.) Alston), *see* Capco, p. 50.

Insect attacking the leaves

HOMOPTERA

Florida red scale:

[*Chrysomphalus aonidum* (Linn.)], Diaspididæ = *Chrysomphalus ficus* Ash.	(Baltazar & Capco, 1960)

TAMPOI (SYZYGIUM JAMBOS (Linn.), *see* Capco, p. 50.

Pests attacking the leaves

ACARINA

Mite:

Oligonychus coffeæ (Nietner), Tetranychidæ	Rimando, 1962b

LEPIDOPTERA

Leaf feeder:

Hedya (*Cellifera*) *cellifera* (Meyrick), Olethreutidæ	Diakonoff, 1967

GUAVA (PSIDIUM GUAJAVA Linn.), *see* Capco, p. 51.

Insects attacking the stem and branches

ISOPTERA

Termite:

Neotermes spp., Kalotermitidæ	Snyder & Francia, 1962

Pests attacking the young shoots & leaves

LEPIDOPTERA

Strepsicrates ejectana (Walker), Olethreutidæ	Diakonoff, 1967
Tussock moth:	
Lymantria lunata (Cram.), Lymantriidæ	Novero, 1958

HOMOPTERA

Wax scales:	
Ceroplastes rubens Mask., Coccidæ	Morrison, 1920
Ceroplastes sinensis del Guercio, Coccidæ	Baltazar, 1962b
Ceroplastodes cajani (Mask.), Coccidæ	Morrison, 1920
Leafhopper:	
Thaumatoscopus reflexus (Stal), Cicadellidæ	New record
Aphid:	
Greenidea formosana (Maki), Aphididæ	Calilung, 1967

ACARINA

Mites:	
Eotetranychus spanius Rimando, Tetranychidæ	Rimando, 1962a
Oligonychus biharensis (Hirst), Tetranychidæ	Rimando, 1962b

Insect attacking the fruits

DIPTERA

Fruitfly:	
Drosophila ananassæ (Doles.), Drosophilidæ (Identified in 1965 by Dr. D. E. Hardy, Univ. of Hawaii, Honolulu)	New record

LANZON (LANSIUM DOMESTICUM Correa), *see* Capco, p. 52.

Insects attacking trunk and branches

ISOPTERA

Mound-building termite:	
Macrotermes gilvus Hagen, Termitidæ	Celino, 1964

LEPIDOPTERA

Green moth:	
Prasinoxena sp., Galleriidæ	Viado & Banaag, 1958
Red-banded bark borer:	
Ereunitis sp., Tineidæ	Celino, 1964
White bark borer:	
Eretmocera sp., Heliodinidæ	Celino, 1964

COLEOPTERA

Long-horned beetles:	
Coelesterna pulchellator Westw., Cerambycidæ	Celino, 1964
Dihammus sp., Cerambycidæ	Celino, 1964
Thestus sp., Cerambycidæ	Celino, 1964
Shot-hole borer:	
Xyleborus sp., Scolytidæ	Celino, 1964

Insects attacking young shoots and leaves

LEPIDOPTERA

Measuring caterpillar:	
Hyposidra sp., Geometridæ	Celino, 1964
Atlas moth:	
Attacus atlas Linn., Saturniidæ	Celino, 1964

COLEOPTERA

Snout weevil:	
Mecopus sp. or near, Curculionidæ	Celino, 1964

HEMIPTERA

Shield bug:	
Brachyplatys deplanatus (Esch.), Pentatomidæ	Celino, 1964
Mirid bug:	
Helopeltis sp., Miridæ	Celino, 1964
Lacebug:	
Stephanitis typicus (Dist.), Tingidæ	Celino, 1964
Cotton stainer:	
(*Dysdercus megalopygus* Breddin), Pyrrhocoridæ =*Dysdercus cingulatus* (F.)	Celino, 1964

HOMOPTERA

Black aphid:	
Toxoptera aurantii (Fonsc.), Aphididæ	Celino, 1964
Scale:	
Asterolecanium sp., Pseudococcidæ	Celino, 1964

Pest other than insects

Giant African snail:	
Achatina fulica Bow., Achatinidæ	Celino, 1964

Insect attacking the fruits

HYMENOPTERA

Red fire ant:	
Solenopsis geminata rufa (Jerdon), Formicidæ	Celino, 1964

MABOLO (DIOSPYRUS DISCOLOR Willd.), *see* Capco, p. 54.

Insect attacking the branches

COLEOPTERA

Shot-hole borer:

Hypothenemus setosus (Eichh.), Scolytidæ (Identified by Dr. S. L. Wood, Brigham Young Univ., Provo, Utah) — New record

Insect attaching young shoots and leaves

HOMOPTERA

Florida red scale:

[*Chrysomphalus aonidum* (Linn.)], Diaspididæ =*Chrysomphalus ficus* Ash. — (Capco & Baltazar, 1960); Deang, 1962

MANGO (MANGIFERA INDICA Linn.), *see* Capco, p. 54.

Insect attacking the stem

LEPIDOPTERA

Bark borer:

Syntomaula simulatella (Walker), Cosmopterygidæ — Diakonoff, 1967

Insects attacking the leaves

HOMOPTERA

Florida red scale:

[*Chrysomphalus aonidum* (Linn.)], Diaspididæ =*Chrysomphalus ficus* Ash. — (Baltazar & Capco, 1960)

Wax scales:

Ceroplastes rubens Mask., Coccidæ — New record

Ceroplastes sinensis del Guercio, Coccidæ — Baltazar, 1962b

Leafhopper:

Nephesa rosæ (Spinola), Flatidæ (Identified in 1965 by Dr. J. Kramer, USDA) — New record

Insect attacking the seeds

LEPIDOPTERA

Seed borer:

Noorda albizonalis Hampson (Identified in 1967 by Mr. M. Shaffer, BMNH) — New record

PAPAYA (CARICA PAPAYA Linn.), *see* Capco, p. 57.

Pests attacking the leaves

LEPIDOPTERA

Tussock moth:

Lymantria lunata (Cram.), Lymantriidæ — Novero, 1958

HOMOPTERA

Florida red scale:

[*Chrysomphalus aonidum* (Linn.)], Diaspididæ =*Chrysomphalus ficus* Ash. — (Capco & Baltazar, 1960); Deang, 1962

ACARINA

Mite:

Calacarus brionesæ Keifer, Eriophyidæ — Keifer, 1963

RAMBUTAN (NEPHELIUM LAPPAGEUM Linn.), *see* **Capco, p. 58.**

Insect attacking the stem or trunk and branches

LEPIDOPTERA

Coffee carpenter moth:

* *Zeuzera coffeæ* Nietner, Cossidæ — New record

SANTOL [SANDORICUM KOETJAPE (Burm. F.) Merr.], *see* **Capco, p. 58.**

Insects attacking the stem or trunk and branches

ISOPTERA

Termite:

Neotermes spp., Kalotermitidæ — Snyder & Francia, 1962

COLEOPTERA

Shot-hole beetle:

Platypus jansoni Chap., Platypodidæ — Pangga, 1960

Insects attacking the young shoots and leaves

HOMOPTERA

Wax scale:

Ceroplastes sinensis del Guercio, Coccidæ — Baltazar, 1962b

Tree hopper:

Gargara luconica (Fairm.), Membracidæ — New record

SINIGUELAS (SPONDIAS PURPUREA Linn.), *see* **Capco, p. 59.**

Insect attacking the leaves

LEPIDOPTERA

Tussock moth:

Lymantria lunata (Cram.), Lymantriidæ — Novero, 1958

TAMARIND (TAMARINDUS INDICUS Linn.), *see* **Capco, p. 60.**

Insect attacking the branches

COLEOPTERA

Shot-hole borer:

Hypothenemus setosus (Eichh.), Scolytidæ (Identified in 1964 by Dr. S. L. Wood, Brigham Young Univ., Provo, Utah) — New record

Insect attacking the leaves

LEPIDOPTERA

Tussock moth:

Lymantria lunata (Cram.), Lymantriidæ — Novero, 1958

TIESA (LUCUMA NERVOSA A. DC.), *see* **Capco, p. 60.**

Insect attacking the young shoots and leaves

HOMOPTERA

Wax scale:
Ceroplastes sinensis del Guercio, Coccidæ — Baltazar, 1962b

PECHAY (BRASSICA PEKINENSIS (Lour.) Gapnep.), *see* Capco, p. 61.

Pest attacking the leaves

ACARINA

Mite:
Tetranychus truncatus Ehara, Tetranychidæ — Rimando, 1962b

PATOLA (LUFFA sp.), *see* Capco, p. 62.

Insect attacking the leaves

COLEOPTERA

Leaf beetle:
Aulacophora cottigarensis (Weise), Chrysomelidæ — New record

SQUASH (CUCURBITA MAXIMA (Duch.)), *see* Capco, p. 62.

Pest attacking the leaves

ACARINA

Mite:
Tetranychus truncatus Ehara, Tetranychidæ — Rimando, 1962b

GARLIC (ALLIUM SATIVUM Linn.), *see* Capco, p. 66.

Pest attacking the leaves

ACARINA

Mite:
* *Aceria tulipæ* (Keifer), Eriophyidæ — (Garcia, 1960)

Insects attacking stored bulbs

COLEOPTERA

Cigarette beetle:
Lasioderma serricorne (F.), Anobiidæ — New record

LEPIDOPTERA

Tobacco moth:
Ephestia elutella (Hubn.), Pyralidæ — Banaag *et al*, 1961

Angoumois grain moth:
Sitotroga cerealella (Oliv.), Gelechiidæ — New record

ONION ALLIUM SEPA Linn.), *see* Capco, p. 66.

Insects attacking the leaves

HOMOPTERA

Whitefly:
Bemisia tabaci (Genn.), Aleyrodidæ — New record

Cutworm:
Prodenia litura (Fabr.), Noctuidæ — New record

PEAS (PISUM SATIVUM Linn.), *see* Capco, p. 66.

Pests attacking the leaves

DIPTERA

Leafminer:

Phytomyza atricornis Meigen, Agromyzidæ — New record
(Identified in 1965 by Dr. G. Steyskal, USNM)

ACARINA

Mite:

Tetranychus truncatus Ehara, Tetranychidæ — Rimando, 1962b

SIGUEDILLAS (PSOPHOCARPUS TETRAGONOLOBUS (Linn.) D.C.), *see* **Capco, p. 66.**

Pests attacking the leaves

ACARINA

Mites:

Eotetranychus orientalis (Klein), Tetranychidæ — Rimando, 1962a
Tetranychus truncatus Ehara, Tetranychidæ — Rimando, 1962b

BEANS (PHASEOLUS Spp.), *see* **Capco, p. 66.**

Insects attacking the blossoms and pods

LEPIDOPTERA

Bean lycaenid:

Catachrysops cnejus (F.), Lycaenidæ — Uichanco & Sacay 1949

Pyralid:

Maruca testulalis (Geyer), Pyraustidæ — (Fontanilla, 1959)

Noctuids:

Heliothis (Helicoverpa) armigera Hubn., Noctuidæ — (Fontanilla, 1959)
Prodenia litura (F.), Noctuidæ — (Fontanilla, 1959)
[*Plusia chalcites* (Esper)], Noctuidæ — (Fontanilla, 1959)
= *Chrysodeixis chalcites* (Esper)

Tussock moth caterpillar:

Euproctis innotata Walk., Lymantriidæ — (Fontanilla, 1959)

Tortricid:

Homona sp., Tortricidæ — (Fontanilla, 1959)

HOMOPTERA

Whitefly:

Bemisia tabaci (Genn.), Aleyrodidæ — New record

Insect attacking stored seeds

COLEOPTERA

Bruchid:

Acanthoscelides obtectus (Say), Bruchidæ — Schultze, 1915

PEPPER (CAPSICUM ANUUM Linn.), *see* **Capco, p. 69.**

Insects attacking the leaves

HOMOPTERA

Whitefly:

Bemisia tabaci (Genn.), Aleyrodidæ — New record

LEPIDOPTERA

Tussock moth:

Lymantria lunata (Cram.), Lymantriidæ — Novero, 1958

Insect attacking the fruits

DIPTERA

Fruitfly:

Dacus (*Strumeta*) *pedestris* (Bezzi), Tephritidæ (Identified in 1964 by Dr. D. E. Hardy, Univ. of Hawaii, Honolulu) — (Antonio, 1964)

EGGPLANT (SOLANUM MELONGENA Linn.), *see* Capco, p. 69.

Pests attacking the leeaves

HOMOPTERA

Whitefly:

Bemisia tabaci (Genn.), Aleyrodidæ — (Olivares, 1965)

COLEOPTERA

Ladybird beetle:

Epilachna philippinensis remota Dieke, Coccinellidæ — New record

LEPIDOPTERA

Tussock moth:

Lymantria lunata (Cram.), Lymantriidæ — Novero, 1958

ACARINA

Mites:

Tetranychus neocaledonicus Andre, Tetranychidæ — Rimando, 1962b

Tetranychus truncatus Ehara, Tetranychidæ — Rimando, 1962b

Brevipalpus obovatus Donnadieu, Tenuipalpidæ — Rimando, 1962b

TOMATOES (LYCOPERSICUM ESCULENTUM Mill.), *see* Capco, p. 69.

Insect attacking the leaves

COLEOPTERA

Ladybird beetle:

Epilachna philippinensis remota Dieke, Coccinellidæ — New record

GINGER (ZINGIBER OFFICINALE Rosc.).

Insect attacking the roots

DIPTERA

Root borer:

Mimegralla coeruleifrons (Macq.), Micropezidæ — Steyskal, 1964

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II. A CHECKLIST OF PHILIPPINE PLANT PESTS

This list incorporates all the insects and other arthropods, snails, rats, monkeys, bats, birds, and others known to attack cultivated plants in the Philippines but excluding ornamental plants. It combines Capco's list and the supplement presented earlier in this paper but grouped into the different orders, families, and subfamilies. The arrangement was to treat the largest group Insecta first and then followed by pests other than insects. A total of 670 insect pests, 34 mites, and 21 miscellaneous pests have been classified.

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Class INSECTA

Order ORTHOPTERA

Family Gryllidæ:

Acheta testaceus (Walker)
Gryllus bimaculatus De Geer
Rhaphidophora deusta Brunner
Oecanthus indicus Saussure

Family Gryllotalpidæ:

Gryllotalpa africana Palisot de Beauvais

Family Acrididæ:

Aiolopus tamulus (Fabricius)
Atractomorpha psittacina (Haan)
Catantops (Stenocatantops) *splendens* (Thunberg)
Gastrimargus marmoratus (Thunberg)
Locusta migratoria manilensis (Meyne) (Includes Philippine records of *L. cinerascens* (Fabricus) and *L. danica* Linnæus)
Melicodes tenebrosa tenebrosa (Walker)
Oxya intricata Stål
Oxya velox (Fabricius)
Patanga succincta (Linnæus)
Trilophidia annulata (Thunberg)
Trilophidia cristella Stål
Valanga nigricornis (Burmeister)

Family Tettigoniidæ:

Euconocephalus varius Walker
Mecopoda elongata (Linnæus)
Phaneroptera furcifera Stål
Sexava sp.

Order ISOPTERA

Family Termitidæ:
Neotermes spp.
Family Termitidæ:
Heterotermes philippinensis (Light)
Hospitalitermes luzonensis (Oshima)
Macrotermes gilvus (Hagen)
Microderotermes losbañosensis (Oshima)
Nasutitermes luzonicus (Oshima)
Family Rhinotermitidæ:
Coptotermes vastator Light
Coptotermes sp.

Order THYSANOPTERA

Family Thripidæ:
Bussothrips claratibia Moulton
Frankliniella williamsi Hood
Gynaikothrips chavicæ Zimmerman
Heliothrips sp.
Hercothrips striatopterus (Kobus)
Selenothrips rubrocinctus (Giard)
Tæniothrips longistylus Karny
Thrips oryzæ Williams
Thrips sacchari Krug.
Thrips serratus Kobus
Thrips tabaci Lindeman

Order HOMOPTERA

Family Machærotidæ:
Machærota ensifera Burmeister
Family Membracidæ:
Gargara luconica (Fairm.)
Leptocentrus manilænsis Funkhouser

Tricentrus convergens (Walker)
Tricentrus plicatus Funkhouser
Sipylus sp.

Family Cicadellidæ:

Bothrogonia ferruginea (Fabricius)
Bothrogonia spp.
Chunrocerus niveosparsa (Lethierry)
(=*Chunra niveosparsa*)
Cicadella bipunctifrons (Stål)
Cicadulina bipunctella Matsumura
(=*Cicadella bipunctella*)
Cofana makilingensis (Baker)
(=*Cicadella makilingensis*)
Empoasca biguttula (Ishida)
(=*Empoasca flavescens* (Fabricius)
Eutettix sp.
Idioscopus clypealis (Lethierry)
(=*Idiocerus clypealis*)
Inazuma dorsalis (Motschulsky)
Ipocerus sp., nr. *kirkaldyi* Baker
Krisna sp., nr. *olivascens* Baker
Makilingia colorata Baker
Makilingia nigra Baker
Nephotettix apicalis (Motschulsky)
Nephotettix cincticeps (Uhler)
Nephotettix impicticeps Ishihara
(=*Nephotettix bipunctatus* Fabricius)
Nirvana pallida Melichar
Nirvana philippinensis Baker
Scaphoideus fasciatus Osborn
Scaphoideus morosus Melichar
Tartessus ferrugineus (Walker)
Tettigella spectra (Distant)
Thaia subrufa (Motschulsky)
(=*Zygina subrufa*)
Thaumatoscopus reflexus (Stål)
Typhlocyba nigrobilineata Melichar

Family Delphacidæ:

Delphacodes sp.
Eumetopina flavipes Muir
Laodelphax striatella (Fallen)
Liburnia sp.
Nilaparvata lugens (Stål)
Paranda globiceps Melichar
Peregrinus maidis (Ashmead)
Perkinsiella bakeri Muir
Perkinsiella fuscipennis Muir
Perkinsiella lineata Muir
Perkinsiella manilæ Muir
Perkinsiella pseudosinensis Muir
Perkinsiella saccharicida Kirkaldy
Perkinsiella saccharivora Muir
Perkinsiella vastatrix (Breddin)
Sogatella furcifera (Horvath)
(=*Sogata furcifera*)
Stenocranus agamopsyche Kirkaldy
Tarophagus proserpina (Kirkaldy)
Tropidocephala saccharivorella Matsumura
Ugyops impictus (Stål)

Family Tropiduchidæ:

Catullia substestacea Stål
Kallitaxila cruenta (Melichar)
(=*Taxilana cruenta*)
Kallitaxila granulata (Stål)
(=*Taxilana granulata*)

Family Meenoplidæ:

Nisia alba Melichar
Nisia atrovenosa (Lethierry)

Family Derbidæ:

Heronax maculipennis (Melichar)
Herpis flavescens Muir
Kamendaka (*Eosaccharissa*) *pulchra* (Muir)
Kamendaka (*Kamendaka*) *tayabasensis* Muir

Kamendaka sp.
Lamenia flavescens Melichar
Leptaleocera nigrofasciata Muir
Mysidioides sp., nr. *tagalica* Muir
Nesokaha lineata Muir
Nesokaha philippina Muir
Nesokaha rubrinervis Muir
Pamendanga sp., nr. *fuscipennis* (Muir)
Phaciocephalus sp., prob. *badius* Muir
Proutista moesta (Westwood)
Proutista sp., nr. *lumholtzi* (Kirkaldy)
Pyrrhoneura maculata Muir
Zeugma valdezi Muir
Zoraida mcgregori Muir

Family Dictyopharidæ:

Chanitus sp., nr. *gramineus* Fabricius
[=*Chanitus pallida* (Donovan)]
Chanitus sp.
!(*Dictyomorpha hectica* Haupt)

Family Flatidæ:

Lawana candida (Fabricius)
Lawana spp.
Nephesa rosæ (Spinola)
Uxantis consputa (Stål)

Family Lophopidæ:

Lophops carinata (Kirby)
Lohops zebra (Walker)
Virgilia luzonensis Baker

Family Nogodinidæ:

Mindura sp., nr. subfasciata Stål

Family Ricaniidæ:

Euricania sp.
Farona funerula (Melichar)
(=*Ormenis funerula*)
Ricania fumosa (Walker)
(=*Ricania proxima* Melichar)
Ricania speculum (Walker)
Ricania tæniata Stål

Family Psyllidæ:

Diaphorina citri (Kuwayama)
Megatrioza vitiensis (Kirkaldy)

Family Aphididæ:

Subfamily Macrosiphinæ:

Macrosiphum (*Sitobion*) *graminis* (Takahasi)
[=*Macrosiphum avenæ* (Fabricius)]
Macrosiphum (*Sitobion*) *miscanthi* (Takahashi)
Macrosiphum (*Sitobion*) sp., nr. *smilacifolium*
Myzus persicæ (Sulzer)
Pentalonia nigronervosa Coquerel

Subfamily Aphidinæ:

Aphis craccivora Koch
(=Philippine records of *Aphis fabæ* Scopoli & *A. laburni* Kaltenbach)
Aphis gossypii Glover
Hysteroneura setariæ (Thomas)
Lipaphis erysimi (Kaltenbach)
[=Philippine records of *Brevicoryne brassicæ* (Linnæus) & *Rhopalosiphum pseudobrassicæ* (Davis)]
Longiunguis sacchari (Zehntner)
Rhopalosiphum maidis (Fitch)
Rhopalosiphum nymphææ (Linnæus)
[=*Rhopalosiphum prunifoliæ* (Fitch)]
Rhopalosiphum padi (Linnæus)
Schizaphis graminum (Rondani)
(=*Toxoptera graminum*)
Toxoptera aurantii (Fonscolombe)
Toxoptera citricida (Kirkaldy)
(=*Aphis citricidus*)

Subfamily Hormaphidinæ (=Thelaxinæ):

Cerataphis variabilis H. R. Lambers
[=Philippine record of *Cerataphis lataniæ* (Boisduval)]
Astegopteryx bambusæ Buckton
Astegopteryx nipæ (Van der Goot)
Ceratovacuna lanigera (Zehntner)
Oregma similis Van der Goot

Subfamily Greenideinæ:

Greenidea formosana (Maki)

Subfamily Eriosomatinæ:

Geoica lucifuga (Zehntner)
Tetraneura nigriabdominalis (Sasaki)
(=*Tetraneura hirsuta* Baker)
Tetraneura oryzæ Van der Goot

Family Aleyrodidæ:

Aleurocanthus spiniferus Quaintance
Aleurocanthus spinosus (Kuwana)
Aleurocanthus woglumi Ashby
Aleurocanthus sp.
Aleurocybotus setiferus Quaintance and Baker
Aleurodes lactea Zehntner
Aleurodicus destructor Mackie
Aleurolobus barodensis Maskell
(=*Aleurolobus longicornis* Zehntner)
Bemisia tabaci (Gennadius)
[=*Bemisia inconspicua* (Quaintance)]
Dialeurodes citri (Ashmead)
Neomaskellia bergii (Signoret)

Family Margarodidæ (=Monophlebinæ):

Crypticerya jacobsoni (Green)
(=*Icerya jacobsoni*)
Drosicha townsendi (Cockerell)
Icerya ægyptica (Douglas)
Icerya seychellarum (Westwood)

Family Pseudococcidæ:

Antonina graminis (Maskell)
(=*Antonina indica* Green)
Antonina zonata Green
Dysmicoccus brevipes (Cockerell)
(=*Pseudococcus brevipes*)
Ferrisia virgata (Cockerell)
(=*Ferrisiana virgata, Pseudococcus virgata*)
Nipæcoccus filamentosus (Cockerell)
(=*Pseudococcus filamentosus*)
Palmicultor palmarum (Ehrhorn)
(=*Pseudococcus palmarum*)
Planococcus citri (Risso)
(=*Pseudococcus citrus*)
Planococcus lilacinus (Cockerell)
(=*Pseudococcus lilacinus*)
Pseudococcus citriculus Green
Puto mangiferæ (Green)
Rastrococcus spinosus (Robinson)
(=*Puto spinosus*)
Saccharicoccus sacchari (Cockerell)
(=*Trionymus sacchari*)

Family Asterolecaniidæ:

Asterolecanium bambusæ (Boisduval)
Asterolecanium sp.

Family Coccidæ:

Ceroplastes rubens Maskell
Ceroplastes sinensis del Guercio
Ceroplastodes cajani (Maskell)
Coccus hesperidum Linnaeus
Coccus mangiferæ Green
Coccus virids (Green)
Pulvinaria polygonata Cockerell

Pulvinaria psidii Maskell
Saissetia coffeæ (Walker)
[= *Saissetia hemisphærica* (Targioni-Tozzetti)]
Saissetia nigra (Nietner)
Saissetia oleæ (Bernard)
Saissetia triangularum Morrison
Vinsonia stellifera (Westwood)

Family Lacciferidæ:

Tachardina minuta (Morrison)
(= *Tachardia minuta*)

Family Diaspididæ:

Aonidiella aurantii (Maskell)
Aonidiella comperei McKenzie
Aonidiella inornata McKenzie
Aonidiella orientalis (Newstead)
Aspidiotus destructor Signoret
(= *Aspidiotus translucens* Cockerell and Robinson)
Aulacaspis tegalensis (Zehntner)
Chionaspis depressa Zehntner
Chionaspis saccharifolii (Zehntner)
Chrysomphalus dictyospermi (Morgan)
Chrysomphalus ficus Ashmead
(= *Chrysomphalus aonidum* of authors)
Fiorinia fioriniæ (Targioni-Tozzetti)
Hemiberlesia lataniæ (Signoret)
(= *Aspidiotus lataniæ*)
Hemiberlesia palmæ (Cockerell)
(=*Aspidiotus palmæ*)
Hemiberlesia rapax (Comstock)
(= *Aspidiotus rapax*)
Lepidosaphes beckii (Newman)
Lepidosaphes gloverii (Packard)
Lepidosaphes lasianthi (Green)
Lepidosaphes mcgregori (Banks)
Lepidosaphes rubrovittatus Cockerell
Lepidosaphes unicolor Banks
Lepidosaphes spp.
Odonaspis saccharicaulis (Zehntner)
Parlatoria pergandii Comstock
(= *Parlatoria sinensis* Maskell)
Parlatoria proteus (Curtis)
Parlatoria ziziphus (Lucas)
Phenacaspis inday (Banks)
Pinnaspis aspidistræ (Signoret)
Pinnaspis strachani (Cooley)

Order HEMIPTERA

Family Miridæ:

Cyrtopeltis tenuis (Reuter)
Halticus minutus Reuter
Helopeltis bakeri Poppius
Helopeltis collaris Stal
Helopeltis sp.
Monalion sp.
Sinervus basalis (Poppius)
(= *Prodromopsis basalis*)

Family Tingidæ:

Stephanitis typicus (Distant)

Family Lygæidæ:

Elasmolomus sordidus (Fabricius)
(= *Aphanus sordidus*)
Graptostethus sp.
Malcus flavipes Stål
Oxycarenus hyalinipennis (Costa)
Oxycarenus lugubris (Motschulsky)

Family Pyrrhocoridæ:

Antilochus nigripes (Burmeister)
Dysdercus cingulatus (Fabricius)
(= *Dysdercus megalopygus* Breddin)

Dysdercus poecilus (Herrich-Schæffer)
Macroceræa grandis (Gray)

Family Coreidæ:

Acanthocoris clavipes (Fabricius)
Acanthocoris scabrator (Fabricius)
Anoplocnemis phasiana (Fabricius)
Cletus pugnator (Fabricius)
(= *Cletus bipunctatus* Westwood)
Cletus trigonus (Thunberg)
Homoecerus puncticornis (Burmeister)
Leptocorixa acuta (Thunberg)
Leptocorixa corbetti China
Leptocorixa costalis Herrich-Schæffer
Leptocorixa discoidalis Walker
Leptocorixa geniculata China
Leptocorixa varicornis (Fabricius)
Leptoglossus membranaceus (Fabricius)
Physomerus grossipes (Fabricius)
Riptortus linearis (Fabricius)
Riptortus pedastris fuscus (Fabricius)
Riptortus pilosus (Thunberg)

Family Cydnidæ:

Aethus indicus (Westwood)
Geotomus pygmæus (Dallas)
Lactistis rastellus Schiodte
Macroscytes transversus Burmeister
Stibaropus callidus Schiodte
Stibaropus molginus Schiodte

Family Pentatomidæ:

Brachyplatys deplanatus (Eschscholtz)
Brachyplatys deplanatus radians Vollan
Brachyplatys vahlii (Fabricius)
Coptosoma angularis Stål
Coptosoma atomarium (Germar)
Coptosoma cinctum (Eschscholtz)
Coptosoma cribrarium (Fabricius)
Agonoscelis nubilis (Fabricius)
Antestiopsis cruciata (Fabricius)
(= *Antestia cruciata*)
Chrysocaris germari (Eschscholtz)
Cyclopelta obscura (Lepeletier et Serville)
Dalpada versicolor (Herrich-Schæffer)
Eurydema pulchra (Westwood)
Nezara viridula (Linnæus)
Rhynchocoris longisrostris Stål
Tessarotoma longicorne Dohrn.
Tectocoris diopthalmus Thunberg
(= *Tectocoris lineola* Fabricius)
Tectocoris diopthalmus peregrina Kirkaldy

Order COLEOPTERA

Family Cicindelidæ:

Collyris albitarsis Erichson

Family Lucanidæ:

Aegus acuminatus (Fabricius)

Family Scarabæidæ:
Subfamily Rutelinæ:

Adoretus luridus Blanchard
Adoretus ranunculus Burmeister
Adoretus sinicus Burmeister
Adoretus tenuimaculatus Waterhouse
Adoretus spp.
Anomala anoguttata Burmeister
(= *Adoretus anoguttatus*)
Anomala humeralis Burmeister
Anomala nerissa Ohaus
Anomala pulchripes Lansberge

Anomala quadricalcarata Ohaus
Anomala sulcatula Burmeister
Anomala spp.
Euchlora spp.
Parastasia canaliculata Westwood
Popillia cetrata Newman

Subfamily Melolonthinæ:

Apogonia bakeri Moser
Apogonia sp.
Autoserica nigrorubra Brenske
Autoserica spp.
Holotrichia flacki Brenske
Holotrichia mindanaona Brenske
Holotrichia vidua Sharp
Holotrichia spp.
Hoplia maculifera Moser
Lepidiota blanchardi Dalla Torre
Leucopholis irrorata Chevrolat
Serica interrupta Walker
(= *Heteronychus interruptus*)
Stephanopholis philippinensis Brenske

Subfamily Cetoniinæ:

Protætia bifenestrata (Chevrolat)
Protætia ferruginea (Gory et Percheron)
Protætia philippinensis (Fabricius)
Protætia spp.
Thaumastopeus nigritus (Froel.)

Subfamily Dynastinæ:

Alissonotum pauper (Burmeister)
Chalcosoma atlas (Linnæus)
Oryctes gnu Mohn.
Oryctes rhinocerus (Linnæus)
Xylotrupes gideon (Linnæus)

Family Tenebrionidæ:

Alphitobius diaperinus (Panzer)
(= *Alphitobius piceus* Olivier)
Alphitobius lævigatus (Fabricius)
Gnathocerus maxillosus (Fabricius)
Gonocephalum æquatoriale (Blanchard)
(= *Opatrum acutagulum* Fairm.)
Gonocephalum adpressum (Germar)
Gonocephalum bilineatum (Walker)
(= *Opatrum bilineatum*)
Gonocephalum depressum (Fabricius)
(=*Opatrum depressum*)
Palorus ratzeburgii Wissmann
Tribolium castaneum (Herbst)
Tribolium confusum Jacq. Duval

Family Nitidulidæ:

Carpophilus dimidiatus (Fabricius)
Carpophilus mutilatus Erichson

Family Cucujidæ:

Ahasverus advena (Walth)
Cathartus quadricollis (Guerin)
Cryptolestes pusillus (Schonherr)
(= *Læmophloeus pusillus*)
Oxyzæphilus surinamensis Linnæus

Family Cryptophagidæ:

Pharaxonotha kirschi Reitter

Family Buprestidæ:

Agrilus occipitalis Eschsholtz
Belionota sp., prob. *sagittaria* Eschscholtz
Crysochroa bicolor Fabricius
Chrysochroa fulminans (Fabricius)

Family Ostomidæ:

Lophocateres pusillus Klug
Tenebroides mauritanicus (Linnæus)

Family Cleridæ:

Necrobia rufipes (Fabricius)

Family Melyridæ:

Prionocerus coeruleipennis Perty

Family Dermestidæ:

Attagenus megatoma (Fabricius)
[= *Attagenus piceus* (Olivier)]
Trogoderma anthrenoides (Sharp)
Trogoderma granarium Everts

Family Anobiidæ:

Lasioderma serricorne (Fabricius)
Stegobium paniceum (Linnæus)

Family Bostrichidæ:

Bostrychopsis parallela (Lesne)
Dinoderus brevis Horn
Dinoderus minutus (Fabricius)
Heterobostrychus æqualis (Waterhouse)
Rhizopertha dominica (Fabricius)
Xylopsocus capuncinus (Fabricius)
Xylothrips religiosus (Boisduval)

Family Coccinellidæ:

Epilachna philippinensis Dieke
Epilachna philippinensis remota Dieke
Henosepilachna pusillanima (Mulsant)
(= *Epilachna pusillanima*)
Verania crocea (Mulsant)
(= *Verania discolor*)

Family Cerambycidæ:

Subfamily Cerambycinæ:

Aeolesthes induta Newman
Chlorophorus annularis (Fabricius)
Epipedocera lunata Newman
Plocæderus fulvicornis (Guerin)
Xylotrechus quadripes Chevrolat

Subfamily Lamiinæ:

Agnia clara Newman
Apomecyna histrio (Fabricius)
Apomecyna neglecta Pascoe
Batocera numitor Newman
Batocera rubus (Linnæus)
(=*Batocera albofasciata* De Geer)
Coelesterna pulchellator (Westwood)
Dihammus vastator Newman
Dihammus sp.
Eoporis elegans Pascoe
Epepeotes luscus (Fabricius)
Gnoma luzonicum Erichson
Niphonoclea albata (Newman)
(= *Euclea albata*)
Niphonoclea capito (Pascoe)
(= *Euclea capito*)
Oberea sp.
Olenecamptus bilobus (Fabricius)
Pterolophia bigibbera (Newman)
Rondibilis spinosula Pascoe
Sthenias varius (Olivier)
Thestus sp.

Family Chrysomelidæ:

Subfamily Alticinæ:

Altica sp.
Chaetocnema sp.
Longitarsus manilensis Weise
Luperomorpha serricornis Duval
Nisotra gemella (Erichson)
Pagria graphica Weise

Phyllotreta spp.
Psylliodes balyi Jacoby
Psylliodes splendida Harold

Subfamily Galerucinæ:

Amphimela meroorum Weise
Aulacophora cottigarensis (Weise)
Aulacophora flavomarginata (Duval)
(=*Ceratia flavomarginata*)
Aulacophora similis Olivier
(=*Ceratia similis, Orthaulaca similis, Aulacophora coffeæ* Hornst)
Dercetes spp.
Monolepta bifasciata (Hornst)

Subfamily Cassidinæ:

Aspidomorpha fusconotata (Boheman)
Aspidomorpha miliaris Fabricius
Laccoptera tredecim-punctata (Fabricius)
Metriona circumdata (Herbst)

Subfamily Hispinæ:

Asamanguilia walkeri Zehntner
Brontispa angulosa Uhmann
Brontispa banguiensis Uhmann
Brontispa depressa Baly
Brontispa longissima Gestro
Brontispa surigaona Uhmann
Callispa cumingi Baly
Callispa flavescens Weise
Dactylispa bipartita Guerin
Dactylispa cladophora Guerin
Dactylispa infuscata Chapuis
Hispellinus callicanthus (Bates)
Monochirus moestus Baly
Plesispa reichei Chapuis
Prionispa sp.
Promecotheca cumingi Baly
Uroplata walkeri Baly

Family Bruchidæ:

Acanthoscelides obtectus (Say)
Callosobruchus chinensis (Linnaeus)
(=*Bruchus chinensis*)

Family Anthribidæ:

Araecerus faciculatus (De Geer)

Family Curculionidæ:

Subfamily Brachyderinæ:

Tribe Tanymecini:

Hypomeces squamosus (Fabricius)
Tanymecus (*Esamus*) *sciurus* (Olivier)

Tribe Pachyrrhynchini:

Metapocyrtus (*Artapocyrtus*) *derasobaltinus* Heller
Metapocyrtus (*Dolichocephalocyrtus*) *dolosus* Heller
Metapocyrtus (*Dolichocephalocyrtus*) *ruficollis* (Waterhouse)
(=*Metapocyrtus rufithorax* Heller)
Metapocyrtus (*Metapocyrtus*) *derasus* (Boheman)
Metapocyrtus (*Metapocyrtus*) *impius* (Erichson)
Metapocyrtus (*Orthocyrtus*) sp.
Metapocyrtus (*Trachycyrtus*) *adspersus* (Waterhouse)
Metapocyrtus (*Trachycyrtus*) *profanus* (Erichson)
Metapocyrtus (*Trachycyrtus*) *spinipes* (Chevrolat)
Metapocyrtus (*Trachycyrtus*) sp.
Metapocyrtus spp.
Pachyrrhynchus moniliferus Germar
Pachyrrhynchus moniliferus chevrolati Eyd. et Soul.
Pachyrrhynchus reticulatus Waterhouse

Subfamily Zygopinæ:

Mecopus sp.
Nauphaeus linearis (Heller)
Pempherulus affinis (Faust)
(=*Pempheres affinis*)

Subfamily Baridinæ:

Manilabris cucurbitæ Zimmerman

Subfamily Cyladinæ:

Cylas formicarius formicarius (Fabricius)

Subfamily Acalyptinæ:

Amorphoidea lata Motschulsky

Subfamily Rhynchophorinæ:

Cosmopolites sordidus (Germar)
Diocalandra frumenti (Fabricius)
Odoiporus longicollis (Olivier)
Polytus mellerborgi (Boheman)
Rhabdoscelus lineatocollis (Heller)
Rhynchophorus ferrugineus (Olivier)
[=*Rhynchophorus schach* (Fabricius)]
Phynchophorus pascha Boheman
Sitophilus oryzæ (Linnaeus)
(=*Calandra oryzæ*)
Sternochetus mangiferæ (Fabricius)
Trochorhopalus strangulatus (Gyllenhal)

Subfamily Apoderinæ:

Apoderus (*Strigapoderus*) *javanicus* (Jekel)

Family Platypodidæ:

Crossotarsus lecontei Chapuis
Crossotarsus sp.
Platypus jansoni Chapuis

Family Scolytidæ:

Coccotrypes graniceps Eichhoff
Eurydactylus sexspinosus (Motschulsky)
Hypocryphalus obscurus Hopkins
Hypothenemus areccae (Hornung)
Hypothenemus birmanus (Eichhoff)
(=*Stephanoderes birmanus*)
Hypothenemus eruditus Westwood
Hypothenomus hampei (Ferrari)
(=*Stephanoderes hampei*)
Hypothenemus psidii (Hopkins)
(=*Stephanoderes psidii*)
Hypothenemus setosus (Eichhoff)
(=*Stephanoderes setosus*)
Hypothenemus tamarindi (Hopkins)
(=*Stephanoderes tamarindi*)
Hypothenemus sp., prob. *brunneus* (Hopkins)
Scolytomimus pusillus Eggers
Xyleborus affinis Eichhoff
Xyleborus fornicatus Eichhoff
Xyleborus perforans (Wollaston)
(=*Xyleborus testaceous* Walker)
Xyleborus similis Ferrari
Xyleborus spp.

Order LEPIDOPTERA

Family Psychidæ:

Eumeta crameri (Westwood)
(=*Cryptothelea crameri*)
Eumeta fuscescens (Snellen)
(=*Cryptothelea fuscescens*)
Eumeta heckmeyeri (Heylaerts)
(=*Cryptothelea heckmeyeri*)
Eumeta variegata (Snellen)
(=*Cryptothelea variegata*)
Eumeta spp.
(=*Cryptothelea* spp.)
Kophene cuprea Moore

Family Tineidæ:

Ereunitis sp.
Setomorpha rutella Zeller
(=*Setomorpha tineoides* Walsingham)

Family Gracillariidæ:

Acrocercops cramerella Snellen
Gracillaria sp.
Lithocolletis triarcha Meyrick
Phyllocnistis citrella Stainton

Family Heliodinidæ:

Eretmocera sp.
Xestocasis iostrota (Meyrick)

Family Hyponomeutidæ:

Plutella xylostella (Linnaeus) [=*Plutella maculipennis* (Curtis)]
Prays endolemma Diakonoff [=*Prays citri* (Milliere), =*Prays endocarpa* of authors]

Family Gelechiidæ:

Eustalodes anthivora Clarke
Pectinophora gossypiella (Saunders)
Phthorimaea heliopa (Lower) (=*Scrobipalpa heliopa*, =*Gnorimoschema heliopa*)
Sitotroga cerealella (Olivier)
Stomopteryx subsecivella (Zeller)

Family Cosmopterygidæ:

Cosmopteryx dulcivora Meyrick (=*Cosmopterix pallifasciella* Snellen)
Pyroderces simplex Walsingham
Syntomaula simulatella (Walker)

Family Oecophoridæ:

Psorosticha neglecta Diakonoff

Family Olethreutidæ (=Eucosmidæ):

Polychrosis sp.
Strepsicrates ejectana (Walker)
Tetramoera schistaceana (Snellen) (=*Eucosoma schistaceana*, =*Olethreutes schistaceana*)

Family Tortricidæ:

Homona bakeri Diakonoff
Homona coffearia Nietner
Homona menciana Walker
Homona phanaea Meyrick
Homona spp.

Family Cossidæ:

Cossus sp.
Zeuzera coffeae Nietner

Family Epipaschiidæ:

Orthaga melanoperalis Hampson

Family Crambidæ:

Chilo suppressalis (Walker) (=*Chilo simplex* of authors)
Chilotraea infuscatella (Snellen)
Chilotraea polychrysa (Meyrick)
Proceras venosatus (Walker)

Family Schoenobiidæ:

Tryporyza incertulas (Walker) (=*Schoenobius incertellus*)
Tryporyza innotata (Walker) (=*Scirpophaga innotata*)
Scirpophaga nivella (Fabricius)
Scirpophaga nivella intacta Snellen

Family Galleriidæ:

Corcyra cephalonica (Stainton)
Prasinoxena sp.

Family Phycitidæ:

Alophia sp.
Etiella zinckeniella (Trietschke)
Heterographis bengalella (Ragonot)

Family Pyraustidæ:

Botydes quinquemaculalis (Sauber)
Cnaphalocrosis medinalis (Guenee)
Crocidolomia binotalis Zeller
Diaphania caesalis (Walker)
Diaphania indica (Saunders) (=*Glyphodes indica*)
Dichocrocis punctiferalis (Guenee)
Doloessa viridis Zeller
Filodes fulvidorsalis (Geyer)
Hymenia recurvalis (Fabricius)

Marasmia trapezealis (Guenee)
Marasmia venilialis (Walker)
Maruca testulalis (Geyer)
Nymphula depunctalis (Guenee)
Nymphula fluctuosalis Zeller
Ostrinia damoalis Walker [=*Pyrausta nubilalis* of authors and Philippine record of *Ostrinia salentialis* (Snellen)]
Psara hipponalis (Walker)
Siboga falsella Snellen
Sylepta derogata (Fabricius)
Sylepta sabinusalis (Walker)

Family Pyralidæ:

Anagasta kuehniella Zeller
Cadra cautella (Walker) (=*Ephestia cautella*)
Ephestia elutella (Hubner)
Noorda albizonalis Hampson
Plodia interpunctella (Hubner)
Pyralis farinalis (Linnaeus)

Family Thyrididæ:

Thodeneura intimalis (Moore)

Family Zygaenidæ:

Artona catoxantha Hampson

Family Limacodidæ:

Parasa lepida (Cramer)
Parasa lorquinii (Reakirt)
Thosea cinereomarginata Banks
Thosea sinensis (Walker)
Thosea spp.

Family Geometridæ:

Hyposidra talaca (Walker)
Hyposidra sp.
Pingasa ruginaria (Guenee)

Family Lymantriidæ:

Dasychira mendosa (Hubner)
Euproctis innotata (Walker)
Euproctis innotata conspersa (Felder)
Euproctis servilis Walker
Euproctis sp.
Laelia subrosea (Walker) (=*Laelia subrufa* Snellen)
Laelia suffusa (Walker)
Lymantria lunata (Cramer)
Lymantria sp.
Orgyia australis postica (Walker)
Porthesia virguncula (Walker) (=*Euproctis virguncula*)

Family Notodontidæ:

Dinara combusta (Walker) (=*Anticyra combusta*)
Stauropus alternus Walker

Family Noctuidæ:

Achaea janata (Linnaeus) (=*Remigia archesia* Guenee)
Agrotis segetum (Denis et Schiffermüller)
Agrotis ipsilon (Hufnagel) (=*Agrotis ypsilon* Rottemburg)
Anomis erosa Hubner (=*Cosmophila erosa*)
Anomis sabulifera (Guenee)
Anticarsia irrorata (Fabricius)
Autoba grisescens Warren
Blenina puloa Swinhoe
Calogramma festiva (Donovan)
Chlumetia transversa (Walker)
Chrysodeixis chalcites (Esper) (=*Plusia chalcites*)
Eearias cupreoviridis (Walker)
Earias fabia (Cramer)
Heliothis (*Helicoverpa*) *armigera* (Hubner)
Heliothis assulta Guenee
Leucania loreyi (Duponchel)
Leucania roseilinea Walker (=*Leucania compta* Moore)
Leucania yu Guenee
Mocis fragalis (Fabricius)
Naranga aenscens Moore
Othreis fullonica (Clerck)
Prodenia litura (Fabricius)
Pseudaletia separata (Walker) (=*Cirphis unipuncta* Haworth, *Leucania unipuncta*)

Sesamia inferens (Walker)
Sesamia uniformis (Dudgeon)
Spodoptera abyssinia Guenee
Spodoptera exempta (Walker)
(=*Laphygma exempta*)
Spodoptera exigua (Hubner)
(=*Laphygma exigua*)
Spodoptera mauritia (Boisduval)
Xanthodes intersepta Guenee
(=*Acontia intersepta*)
Xanthodes transversa Guenee
(=*Acontia transversa*)

Family Ctenuchidæ (=Amatidæ):

Amata sefocca Swinhoe
Euchromia horsfieldi (Moore)

Family Arctiidæ:

Argina cribraria (Clerck)
Creatonotus gangis (Linnaeus)
Diacrisia metarhoda (Walker)
(=*Spilosoma metarhoda*)
Maenas maculifascia (Walker)
Utetheisa lotrix (Cramer)
Utetheisa pulchella (Linnaeus)
(=*Deiopia pulchella*)

Family Saturniidæ:

Antheraea semperi Felder
Attacus atlas (Linnaeus)
Philosamia ricini (Donovan)
(=*Attacus ricini*)

Family Eupterotidæ:

Eupterote favia (Cramer)

Family Lasiocampidæ:

Metanastria hyrtaca (Cramer)
Suana concolor (Walker)

Family Sphingidæ:

Acherontia lachesis (Fabricius)
Agrius convolvuli (Linnaeus)
(=*Protoparce convolvuli*)
Cephonodes hylas (Linnaeus)
Hippotion celerio (Linnaeus)
Rhyncolaba acteus (Cramer)

Family Hesperiidæ:

Cephrenes chrysozona Plotz
Erionota thrax Linnaeus
Padraona nitida Mab.
Parnara mangala Moore
(=*Hesperia philino* Moschler)
Parnara naso bada Moore
Parnara philippina Herrich-Schaeffer
Pelopidas mathias (Fabricius)
(=*Baoris mathias*)
Tagiades titus Plotz
Telicota augias (Linnaeus)

Family Papilionidæ:

Graphium agamemnon (Linnaeus)
(=*Papilio agamemnon*)
Papilio clytia phalephates Westwood
Papilio polytes ledebouria Eschscholtz
Papilio rumanzovia Eschscholtz

Family Pieridæ:

Delias canidia (Vollenhoven)
(=*Pieris canidia* Sparrman)
Terias hecabe (Linnaeus)

Family Satyridæ:

Melanitis leda determinata Butler
Melanitis leda leda (Linnaeus)
Mycalesis mineus (Linnaeus)

Family Nymphalidæ:

Hypolimnas misippus (Linnaeus)

Family Amathusiidæ:

Amathusia phidippus (Johanssen)
Discophora ogina (Godart)

Family Lycaenidæ:

Catachrysops cnejus (Fabricius)
Lampides boeticus (Linnaeus)

Order DIPTERA

Family Micropezidæ:

Mimegralla coeruleifrons (Macquart)

Family Tephretidæ (=Trypetidæ):

Dacus caudatus Fabricius
Dacus cucurbitæ Coquillet
Dacus dorsalis Hendel
Dacus (Paratridacus) expandens (Walker)
Dacus (Strumeta) pedestris (Bezzi)
Dacus umbrosus Fabricius
Monacrostichus citricola Bezzi

Family Lonchaeidæ:

Lonchaea citricola Bezzi

Family Ephydridæ:

Hydrellia philippina Ferino

Family Drosophilidæ:

Drosophila ananassæ (Doleschal)
Drosophila sp.
Zaprionus multistriata Sturtevant

Family Chloropidæ:

Mepachymerus crucifer (Meigen)
Mepachymerus ensifer (Thomas)

Family Agromyzidæ:

Agromyza spp.
Melanagromyza phaseoli (Coquillet)
(=*Agromyza destructor* Malloch)
Napomyza sp.
Phytomyza atricornis Meigen

Family Anthomyiidæ:

Atherigona exigua Stein
Atherigona orientalis Schin.
Atherigona seticauda Malloch

Order HYMENOPTERA

Family Formicidæ:

Solenopsis geminata rufa (Jerdon)

CLASS ARACHNIDA

Order ACARINA

Family Eriophyidæ:

Abacarus oryzae Keifer
Acathrix trymatus Keifer
Aceria tulipae (Keifer)
Calacarus brionesae Keifer
Dialox stellatus Keifer
Notostrix attenuata Keifer
Phyllocoptruta oleivorus Ashmead
Scolaceums spiniferus Keifer
Hemitarsonemus latus (Banks)

Family Tetranychidæ:

Aponychus corpuzae Rimando
Aponychus vannus Rimando
Eotetranychus cendañai Rimando
Eotetranychus orientalis (Klein)
Eotetranychus spanius Rimando
Oligonychus biharensis (Hirst)
Oligonychus coffeae (Nietner)
Oligonychus orthius Rimando
Oligonychus velascoi Rimando
Panonychus citri (McGregor)
Pritchardina fijiensis (Hirst)
Schizotetranychus baltazarae Rimando
Schizotetranychus floresi Rimando
Schizotetranychus lechrius Rimando
Tetranychus exsiccator Zehntner
Tetranychus kanzawai Kishida
Tetranychus neocaledonicus Andre
Tetranychus piercei McGregor
Tetranychus telarius (Linnaeus)
Tetranychus truncatus Ehara
Tetranychus spp.

Family Tenuipalpidæ:

Brevipalpus californicus (Banks)

Brevipalpus obovatus Donnadieu
Brevipalpus phoenicus (Geijskeo)
Dolichotetranychus floridanus (Banks)
Tenuipalpis orilloi Rimando

Class CRUSTACEA

Family Coenobitidæ:

Birgus latro (Linnæus)

Phylum MOLLUSCA

Family Achatinidæ:

Achatina fulica Bowdich

Phylum CHORDATA

Class AVES

Family Ploceidæ:

Munia jagori Martens
Munia orizivora Linnaeus
Oroloncha everitti Tweed

Family Corvidæ:

Corvus macrorhynchus Wagl.

Family Sturnidæ:

Aplonia panayensis (Scopoli)

Family Fringillidæ:

Lonchura ferruginosa jagora (Martens)
Lonchura punctulata cabanisis (Sharpe)
Padda oryzivora (Linnaeus)
Passer mountanus (Linnaeus)

Family Psittacidæ:

Loriculus philippensis philippensis (Muller)
Prioniturus discursus discursus (Vieillot)
Tanygnathus lucionensis lucionensis (Linnaeus)

Class MAMMALIA

Order CHIROPTERA

Family Pteropidæ:

Cynopterus brachyotis luzoniensis (Peters)
Pteropus leucopterus Temminck

Order PRIMATES

Family Cercopithecides:

Macaca philippinensis philippinensis (Geoffrey)

Order RODENTIA

Family Sciuridæ:

Collosciurus juvencus juvencus (Thomas)

Family Muridæ:

Mus castaneus Waterhouse
Rattus rattus mindanensis Mearns
Rattus norvegicus norvegicus (Erxleben)

Order CARNIVORA

Family Viverridæ:

Paradoxurus philippinensis Jourdan

Order ARTIODACTYLA

Family Suidæ:

Sus philippinensis Nehring

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PUBLICATIONS AVAILABLE

CHECKLIST OF THE ANTS (HYMENOPTERA: FORMICIDÆ) OF ASIA. By J. W. Chapman and S. R. Capco. Institute of Science and Technology Monograph 1 (1951) new series. Paper, 372 pages. Price, $2.00, United States currency.

NOTES ON PHILIPPINE MOSQUITOES, XVI. GENUS TRIPTEROIDES. By F. E. Baisas and Adela Ubaldo-Pagayon. Institute of Science and Technology Monograph 2 (1952) new series. Paper, 198 pages with 23 plates and four text figures. Price, $2.50, United States currency.

A REVISION OF THE INDO-MALAYAN FRESH-WATER FISH GENUS RASBORA. By Martin B. Brittan. Institute of Science and Technology Monograph 3 (1953) new series. Paper, 224 pages with 3 plates and 52 text figures. Price, $2.50, United States currency.

SECURING AQUATIC PRODUCTS IN SIATON MUNICIPALITY, NEGROS ORIENTAL PROVINCE, PHILIPPINES. By Donn V. Hart. Institute of Science and Technology Monograph 4 (1956) new series. Paper, 84 pages with 22 text figures and eight plates. Price, $1.25, United States currency.

AN ECOLOGICAL STUDY OF THE KOUPREY, NOVIBUS SAUVELI (URBAIN). By Charles H. Wharton. Institute of Science and Technology Monograph 5 (1957) new series. Paper, 111 pages with 11 plates and 16 text figures. Price, $1.25, United States currency.

FERN FLORA OF THE PHILIPPINES. By Edwin B. Copeland. Institute of Science and Technology Monograph 6, Vols. 1–3 (1958–1960) new series. Vol. 1, 191 p., Paper, Price, $1.25; Vol. 2, 193–376 p., Paper, Price, $1.75; Vol. 3, 377–577 p., Paper, Price $1.75, United States currency.

THE PHILIPPINE PIMPLINI, POEMENIINI, RHYSSINI, AND XORIDINI. By Clare R. Baltazar. National Institute of Science and Technology Monograph 7 (1961) new series. Paper, 120 pages with four plates. Price, $1.50, United States currency.

PACIFIC PLANT AREAS. Edited by C.G.G.J. Van Steenis. National Institute of Science and Technology Monograph 8, Vol. 1 (1963) new series. Paper, 246 pages with 26 maps. Price, $3.00, United States currency.

INDEX TO THE PHILIPPINE JOURNAL OF SCIENCE, VOL. 59 (1936) TO VOL. 79 (1950). By Angel Y. Lira. National Institute of Science and Technology Monograph 9 (1963) new series. Paper, 325 pages. Prices, $3.00, United States currency.

THE ARCHAEOLOGY OF CENTRAL PHILIPPINES. By Wilhelm G. Solheim, II. National Institute of Science and Technology Monograph (1964) new series. Paper, 235 pages with 29 text figures and 50 plates. Price, $3.00, United States currency.

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